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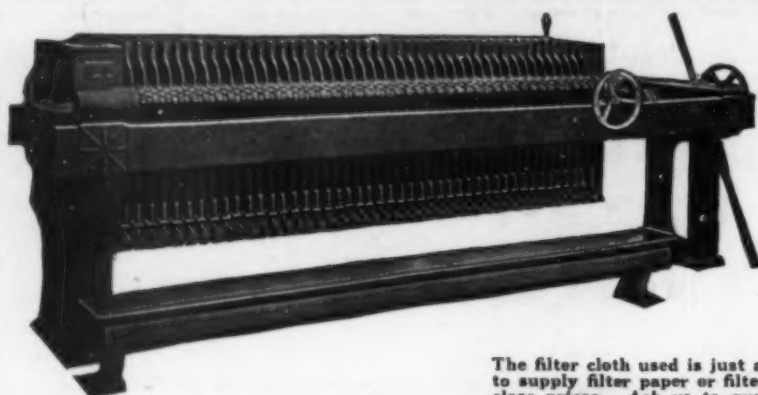
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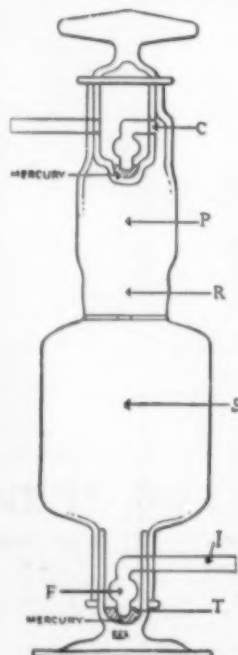
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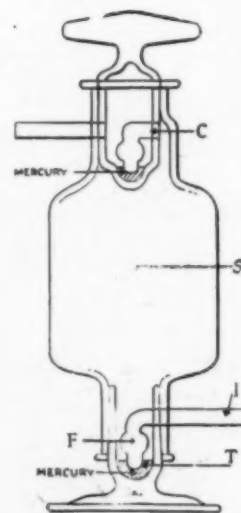
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## The Cost of Technical Control

AT ONE of the recent technical sessions of the Institute of Metals a paper was read describing the very complete technical control of foundry operations connected with experimental developments on army aircraft. While admitting that such close supervision was unnecessary in commercial foundries working with somewhat standardized methods and common analyses, a question was asked from the floor, "What does technical control in the foundry cost?"

The question might be answered from the autobiography of no less an ironmaster than ANDREW CARNEGIE. He was describing the many difficulties encountered during the early operation of the Lucy furnace—an undertaking they "would have postponed if we had realized its magnitude." Little furnaces could be run by rule of thumb and guess, but not such a monster as the Lucy. Finally he employed a Dr. FRICKE, a German chemist, to assist the manager, and straightway "Lucy furnace became the most profitable branch of our business, because we had almost the entire monopoly of scientific management. It was years after we had taken chemistry to guide us that it was said by the proprietors of some other furnaces that they could not afford to employ a chemist. Had they known the truth then, they would have known that they could not afford to be without one."

## Burying the Borax Bugaboo

ALTHOUGH the enemies of American potash probably will continue to echo the borax refrain for some time to come, we are glad to record and give wide publicity to the fact that American potash now meets the standard of purity set by the United States Department of Agriculture. Borax is no longer a deleterious constituent of the American product. In fact for two years the borax content of Searles Lake potash has ranged from 0.27 to 0.5 per cent, comparing favorably with the borax content of sodium nitrate, which is widely used in fertilizing American crops.

We are glad that the Bureau of Soils has seen fit to place its official stamp of approval on American potash, particularly with regard to its borax content, because it was through the investigations of this bureau that borax was found to be the offending element of the domestic product that caused crop injury in Maine and North and South Carolina in 1919. When the producers at Searles Lake had their attention directed to the injurious nature of the borax, they improved their methods of production and eliminated that constituent. For the past two years the Bureau of Soils has analyzed the Searles Lake product with the results given above, and now makes the statement that "under the present method of producing potash at Searles Lake, California,

there no longer exists the former danger to crops from the presence of borax in the fertilizer."

This will disarm the propagandist for German potash of one of his favorite arguments against the domestic product. But he will continue to hark back to the old story, and it will be necessary to spread the latest news broadcast in order effectually to bury the borax bugaboo and kill the prejudice that exists in the minds of the farmers. It should be the pleasant duty of every American to spread this news.

## Marking Time on Muscle Shoals

TIME was when the controversy over Muscle Shoals waged principally about the question of government ownership and operation. Those were the days of Secretary BAKER and the U. S. Fixed Nitrogen Corporation. Both have since passed into the discard and the stage is held by competing bidders whose fortunes wax and wane almost with each succeeding moon. At the present writing Mr. FORD holds a distinct advantage. The House Committee on Military Affairs has made a majority report recommending that Mr. FORD's offer to lease the power projects and buy the nitrate plants be accepted. The committee finds that "the Ford proposal was the only proposal worthy of serious consideration," also that it is "the only proposal sufficiently comprehensive in its terms to meet the requirements of . . . the national defense act." Neither does the minority report reject the Ford offer. In fact it would accept it in whole, whereas the majority report approves it only in part and with certain modifications. But there is a third group that has revolted against Mr. FORD and will have none of his proposal. At first there were only two who bolted, but according to last reports there are now eight members of the House who violently denounce the Ford plan.

Aside from the fact that the name of FORD is one to conjure with in industry, it is not difficult to see why Congress is favorably impressed with his offer. The committee finds that "it is the continuing considerations to be performed by Mr. FORD and his company over a long period of about 100 years which gives to his proposal its merit." What are these "continuing considerations"? First, nitrogen preparedness in the form of Nitrate Plant No. 2 maintained in readiness for production, at full capacity, of nitrogen to be used in the manufacture of explosives. This is cited as a contribution to the national defense for the next hundred years. Second, Mr. FORD proposes for his company that "continuously throughout the lease period . . . it will manufacture nitrogen or other commercial fertilizers . . . at Nitrate Plant No. 2," and that "the annual production of these fertilizers shall have a nitrogen content of at least forty thousand tons of fixed nitrogen, which is the present annual capacity of Nitrate Plant

No. 2." Third, the company agrees that its maximum net profit on the manufacture and sale of fertilizers shall not exceed 8 per cent of the annual cost of production. There are numerous other provisions, all of which point to the sincerity of the proposal and add to its attractiveness.

It will be observed, however, that the Ford offer still contemplates a payment of only \$5,000,000 for the nitrate plants, and a lease of the power project for one hundred years. So far as the latter is concerned the offer of the Alabama Power Company is vastly superior and more equitable to the United States, being in conformity to the terms of the federal waterpower law. There is no comparable offer for the chemical plants, so that we can merely raise the question whether the sale of property having a war-time cost of \$106,000,000 for \$5,000,000 is too large a price to pay for the assurance of nitrogen preparedness in Nitrate Plant No. 2 for the next hundred years. The probability is that the price is too great, although the House Committee on Military Affairs is disposed to pay it. The Senate Committee on Agriculture, however, with the characteristic lack of unanimity now prevailing in Congress, gives evidence of sentiment in favor of a policy of government control and operation. In fact Chairman NORRIS has announced that he will introduce a bill creating a government corporation for this purpose.

And so the controversy goes merrily on. The stage has been held successively by one plan after another, each emanating from a source whose interest was dominant at the moment. First the government felt that as a measure of preparedness it should operate the plant. Then the Ordnance Department felt reassured by the commercial developments in nitrogen fixation and was content to urge the retention of Muscle Shoals in standby condition. This was followed by a series of proposals from private interests to buy, lease and operate the plants, and now that these offers have been debated for months the pendulum is about to swing back toward the policy of government ownership and operation. By the time this idea is again debated some new scheme will be brought forward to furnish a subject for speechmaking and discordant opinion. At the present writing it looks as though Mr. FORD might get Muscle Shoals, but that great project may yet go down in history as our most fruitful cause of diverse opinion and abortive legislation.

## Potash

### Propaganda

**P**ROPAGANDA against the duties on potash is afoot and the farmers in large numbers are writing to their Senators asking that they oppose these duties. Some of those favoring the potash provision in the tariff contend that the German syndicate is back of this propaganda." This statement, taken from some of our recent Washington correspondence, is not in itself very startling, for charges of propaganda and lobbying, especially in connection with the potash tariff, have been all too common. However, we have recently come across some concrete evidence of the propaganda being used by the tariff opponents, and certainly we cannot pass it by without very vigorous protest.

We refer to a most deceptive piece of farm-journal advertising—in this particular case appearing in *The Rural New Yorker* for June 3. It purports to be a stirring appeal to safeguard the vital interests of the American farmer and is published over the name of the

"Soil and Crop Service, Potash Syndicate, H. A. Huston, Mgr." Not one reference is made to the German producers and the manager appears to have been extremely careful not to explain, as he did before the Senate Finance Committee last December, that "there is only one potash syndicate, which is the German Potash Syndicate."

The advertisement implies that the "propagandists" of the domestic industry have "bluffed" Congress into believing that the farmers are not opposed to the tariff, or otherwise the representatives of the national farm organization would have been heard at the tariff hearings. As a matter of fact it is generally known in Washington that these organizations, after requesting and being granted almost prohibitive duties on agricultural products, are not in a position to deny moderate protection to other American industries. Mr. HUSTON, however, is most anxious "to look after legislation affecting the farmers' interests." "The only effective way to do this," he says, "is for farmers to write to both of their United States Senators in Washington urging them to see that the 'joker' at the end of paragraph 1,635 be struck out and that potash used in fertilizers remain on the free list, where it has always been." Thus we have an explanation, perhaps, for the increasing volume of Senatorial mail to which our Washington correspondent has referred.

That word "joker," which plays a prominent part in this deception, is an inference which we cannot help but resent. It is an implication of subterfuge and evasion on the part of the domestic industry, which has at all times squarely and openly presented its case before Congress. But these are not all of even the most patent attempts to be misleading! Witness this paragraph:

During the time when foreign potash could not be obtained, potash sold for more than ten times the pre-war or the present prices. Then the American producers, some of whom are known as the "Borax Brigade," had the opportunity of profiteering to the limit and of selling at very high prices potash of an inferior and sometimes injurious kind.

To those domestic producers who have weathered the storm of depression and the recent flood of foreign potash these charges of profiteering are but grimly humorous. However, the insinuation of the inferior quality of American potash is most indignantly resented. Elsewhere in these columns we tell of how the Department of Agriculture has officially interred the borax bugaboo. Isn't it about time to do the same with some other of the potash propagandist's insidious misrepresentations?

## Errors in

### Brinell Testing

**A**TENTION was recently called, in these columns, to the consistent discrepancies in Brinell hardness of rivet bars from the same heat reported from two government laboratories—a matter worthy of remark because of the impression that accurate tests for hardness are quite easy to make. Only a few years back hardness was an elusive property to measure. Now, with the Brinell ball test and the scleroscope we think we can define the hardness of metal within fairly close limits.

Therefore it may be useful to call attention to the fact that various laboratories making Brinell hardness tests, particularly on soft materials, may show large variations. Usually the metal is reported as being much too soft. For instance, a well-made uniform bar



of a light alloy was sent successively to several metallurgical laboratories. The correct hardness, as reported by the Bureau of Standards, was 91, using a 10-mm. ball and 500-kg. load. The other returns went as low as 63, and seldom approached within ten units of the true figure. Another similar experiment was described by J. V. EMMONS before the Cleveland Steel Treathers. Results on a piece of steel which was truly 170 Brinell units hard varied from 153 to 175!

Five principal precautions are ordinarily mentioned in literature describing the Brinell test. First, the diameter of the ball should be exactly 10 mm.—but by the method of manufacture, hardened balls are usually more accurate than ordinary micrometers. Second, the impression should be carefully measured—as it can be by low-power microscope and line rule, or micrometer eyepiece, except when a very soft metal flows so badly as to round off the edge of the dent. Third, the hardness of the ball should be correct—but that is of little or no moment when measuring hardness below 200. Fourth, the load should be exactly 3,000 kg. (or 500 kg. for soft metal). Here is where many machines are inaccurate, due to defective packing; but the accuracy of the load should often be checked as closely as a good platform scale or tensile testing machine can weigh. Fifth, the full load should be left on the specimen one minute.

Given these things in close adjustment, a large error can easily be made by increasing the speed of loading. In fact, it is so prolific a source of error that it is strange that the rate of loading has not been definitely limited, either by specification or by the construction of the machine.

Most Brinell machines are arranged so that the load is applied by a hydraulic cylinder, wherein the pressure is pumped up by hand and kept from going above the correct figure by a counterweighted piston or float. This seems an admirable and almost foolproof arrangement. But if the pump handle is worked so vigorously that the counterweight finally jumps up suddenly, it is apparent that the pressure in the cylinder—and therefore the weight on the ball—is momentarily lighter than the limiting load by an amount proportional to the friction of the movable parts and their inertia. With the 500-kg. load limit, this excess is a considerable percentage of the total. Consequently a much larger hole is punched into soft metals than their hardness warrants and an abnormal value is obtained.

### Heavy Research

#### In Copper and Brass

MANY vigorous protests have been raised by voices more influential than ours against the scheme, dear to quacks, of gaining reputations by proxy. Thus the fair reputation of engineering has been appropriated by the "financial engineer" or "human engineer," to say nothing of the bright salesman who has just left ribbons and is now selling radio. Our readers will also know that this journal objects to an indiscriminating use of the word "research" whereby it means anything from a hunt through some 'phone directories made by the office boy during a lazy afternoon to the results of the life work of a scholar.

Having these facts in mind, we entertained certain doubts upon learning a year or more ago that the principal copper producers, rolling mills and brass makers had joined in a "Copper and Brass Research Association" headed by such a well-known scientist as

the president of the Calumet & Hecla Mining Co. and advised by no less a consulting engineer on publicity than IVY LEE. A call at their offices confirmed these suspicions. Propaganda, not research, was the object; but "research" is a fine-sounding word. It would lend a certain air to the association's activities.

It excites a feeling almost derisive to find that the association is collecting information by offering fourteen prizes ranging from \$150 to \$10 to "school children and others for the best photographs showing the relative durability of materials which go into the construction of American homes"—for instance, the old oaken bucket, a knocker, name plate, or grandma's preserve kettle, for it must be at least 35 years old. The scheme recalls the request circulated among the grammar grades of the Salt Lake City schools, asking for suggestions whereby that city could become an inland port for ocean-going vessels! (Yes, that actually happened!)

Since the manager of the association frankly admits that research is not its principal aim, he would be well advised to publish the fact by making the name more descriptive of the activities. Otherwise there is grave danger that the lawyers, financiers and business men who direct the copper and brass industry in the United States may conclude that everything possible is being done to extend and recover the old markets and to find new uses for red metal and its alloys. Meanwhile the Morwell electrification installs 700 miles of high-tension conductors of aluminum at a total saving of \$500,000 over copper, France is making subsidiary coinage of aluminum and Russia of paper, and toddle tops are made of wood, celluloid, Bakelite and almost anything but brass.

### Incapacity

#### For Fair Play

NOTHING in the history of organized labor has served to alienate its friends and prejudice its cause so effectively as its acts of violence. Whatever the public sentiment may be, or wherever popular sympathy may lie in any particular labor controversy, there is an instinctive revolt against the side that resorts to violence. Usually labor has been the sufferer.

The recent riot and civil warfare that occurred in Illinois is a particularly atrocious example of the intolerance of organized labor which, in the minds of many of its friends, marks its incapacity for fair play. Reports of the fight recall the stories of atrocities that marked the bitterness of the late war. And instead of reprimand or punishment of any kind President LEWIS publicly announced that members of his union were "justified in treating this crowd as an outlaw organization and in viewing its members in the same light as they would view any other common strike-breakers." A noble industrial policy! A high and lofty plan! If a man does not belong to your organization and wants to work when you will not, he is an outlaw and you treat him as you would "any other common strikebreaker." Evidently the approved form is to shoot him down and then proceed with mob violence to destroy property so that nobody can work unless you can get a job on your own terms.

It is beyond all understanding how the presumably intelligent leaders of labor, to say nothing of their followers, expect to gain permanent victories by pursuing this policy. Public decency is only outraged and public opinion reacts against those who commit or condone the crime.

## Ernest Solvay, 1838-1922

MAY 26, marks the death, at the age of 84, of a man to whom the chemical industry owes one of its most remarkable developments—Ernest Solvay, the genial creator of the ammonia-soda process. If the introduction of this process, about 60 years ago, marks a memorable milestone in the history of the chemical industry, then there is gleaned from the life of the inventor a moral lesson of the highest order, for it shows us what sustained will power can do when obstinately directed toward the goal it has set for itself.

The early youth of Ernest Solvay was not of the easiest sort. He was born on April 16, 1838, in the little Brabantian village of Rebecq-Rognon, where his father performed simultaneously the duties of master of quarries, salt refiner and wholesale commission agent dealing in oils, soaps and groceries. The diversity of his occupations, however, failed to make him rich and unfortunately he was obliged to renounce the dream he had nourished of permitting his son to take up a complete scientific course in college. He sent him, however, when scarcely 16 years of age, to his uncle Semet, director of the gas works of Schaerbeek, one of the suburbs of Brussels. There the young man was put into a rather crude school, but nevertheless all the more wholesome for his future. There he acquired fundamental knowledge of gas technology; and it was there that he conceived the idea of condensing the residual ammoniacal liquors in order to make their handling more economical and later to recover them by distillation from lime. Finally, studying the compounds of ammonia, he was led one day, in 1860, to his scheme for producing bicarbonate of soda, by observing, it is said, the reaction he provoked by grinding ammonium bicarbonate in a mortar and mixing it with sea water. It is, however, not in this discovery that the great merit of Solvay lies. This reaction, which was later completely to revolutionize an industry, was already known—Dyar and Hemming had discovered it in 1838—and several chemists had even foreseen its industrial application. The glory of Solvay was the research with unexampled tenacity into the causes of the difficulties in the process, and finally to surmount innumerable obstacles and bring his process to a successful industrial status.

On April 15, 1861, he took out his first patent in Belgium; the following year he installed a modest ex-

perimental factory near the Place du Marché in Schaerbeek. There, with the help of his brother Alfred, he undertook the elaboration of his discovery. The first experiments resulted in the modest yield of 130 kilos of soda in 12 hours. In 1863 a limited company was established with a capital of 136,000 francs, and a factory was built at Couillet, near Charleroi, but after 5 months the production was still only 227 kilos per day. Thereafter, however, the yield curve rose rapidly; in June, 1866, production had reached 1,500 kilos per day, and double that in December, 1867. In that year, which must always be considered as marking the beginning of the industrial era of the ammonia-soda process, an output of 40,000 tons per year was reached. In 1860 374,000 tons of Leblanc soda was manufactured, and only 300 tons of Solvay soda; in 1902, out of a total production of 1,760,000 tons, the Leblanc process could claim but 150,000 tons.

After the Couillet factory, others sprang up, in France, England, Germany, Russia, Austria and America. Fortune was rewarding the efforts of the inventor, and he was at last able to consecrate himself to occupations of a different character and reveal himself as philanthropist and sociologist of rare conception and accomplishment.

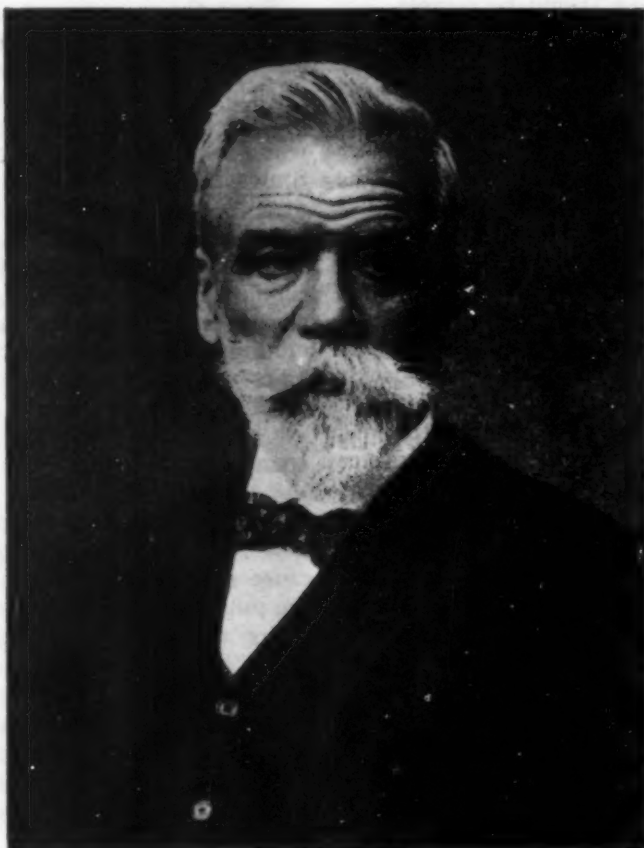
Numerous were the distinctions which consecrated the merit of this eminent man. In 1898 he was made doctor *honoris causa* of the University of Brussels, on which he never ceased to bestow the tokens of his solicitude; the following year the Royal Society of Great Britain elected him an honorary member; on June 18, 1917, he was appointed, almost unanimously, a corresponding member of the chemical department of the Academy of Sciences. He was Grand

Officer of the Legion of Honor as well as of the Order of Leopold. Furthermore, he was one of the most illustrious and most representative honorary members of the Société de Chimie Industrielle.

None of those who had the good fortune to come in contact with this octogenarian, who in spite of his age was still so surprisingly alert, will ever forget the impression of meditative and active energy which emanated from him. Ernest Solvay has left us a luminous example of that most intimate co-operation of pure and applied science, but most of all he will forever be remembered, with all the force of this expression, as a truly great citizen.

PAUL KESTNER.

EDITOR'S NOTE: We desire to express our appreciation to the Société de Chimie Industrielle, to whose official organ, *Chimie et Industrie*, we are indebted for this photograph of Ernest Solvay and his intimate biography by Dr. Paul Kestner.



ERNEST SOLVAY



## Progress in Dust-Explosion Prevention\*

**The Flour-Milling Industry and Dust Explosions—The Federal Investigation of Dust Explosions—Summary of Dust-Explosion Losses in Various Industries—Progress of Dust Collection and Removal and of Adoption of Methods of Preventing Explosions**

By DAVID J. PRICE

Engineer in Charge of Development Work, Bureau of Chemistry,  
U. S. Department of Agriculture, Washington, D. C.

THE flour-milling industry has given considerable attention to dust-explosion prevention and to the development of effective control methods. The explosion in Minneapolis in 1878 may have been largely instrumental in bringing about this interest and resulting in the progress which has been made by this particular industry. The flour millers have co-operated very effectively with the federal government in conducting special research investigations in connection with this problem, and it has been found that the millers were ready to make quick application of any methods of prevention which proved to be effective.

The principal object in presenting this paper is to develop the fact that the flour-milling industry has made significant progress in controlling dust explosions and reducing the losses from this particular cause. It is desired to suggest that recognition be given to this industry, which has demonstrated very definitely that progress can be made in dust-explosion prevention by the application of dust control measures. If similar progress could be made in other representative industries in which explosive dusts are created during operating processes, it is felt that the large losses of life, grain and property in the United States and Canada would be considerably reduced.

An erroneous impression prevails throughout the United States and Canada to the effect that flour mills are a particular hazard. We desire to take this occasion to correct this impression and state that the fire prevention engineers should no longer take the position that an extreme hazard exists in flour milling, and single out this particular industry in referring to our dust-explosion losses. A natural tendency seems to be to class all mills as flour mills. A thorough study of dust explosions for a number of years has definitely shown that the dust-explosion hazard can be classified as it relates to various industries and in this respect the flour-milling industry has made progress that is worthy of recognition.

### ORIGIN OF FEDERAL DUST - EXPLOSION INVESTIGATION

It is scarcely necessary to state that the investigations now being conducted by the federal government were brought about as a result of the interest manifested by the millers of the country, particularly of western New York, following the disastrous explosion at the Husted Milling Co. plant in Buffalo in 1913. The millers' committee, consisting of L. E. Harmon, then president of the Buffalo Cereal Co., F. F. Henry, manager of the Washburn-Crosby Co., and George P. Urban, of the Urban Milling Co., made it possible for the federal Bureau of Mines to co-operate with the milling

industry in a thorough study of the causes of these dust explosions with a view to developing some methods of prevention. The active interest manifested by this committee and the provision made by it for conducting both the necessary engineering and chemical research investigations has been of unmeasured value to American industries.

This work, started by the millers, has resulted in its extension to various types of industries in which disastrous losses have occurred from these dust explosions and fires. It has also led to a thorough investigation of explosions and fires in grain-threshing machines during threshing operations. These explosions occurred about the time the millers made provision for undertaking the work, and the investigations have resulted in the suggestion and adoption of control measures which have been very effective on grain separators, particularly in the Pacific Northwest. It has also extended to the study of fires in cotton gins in the South, in which extensive losses have been experienced. The information obtained in the dust-explosion investigations made possible effective precautionary measures for the control of these cotton-gin fires. In fact the data obtained in the dust-explosion investigations as a whole have found application in the study of various types of explosions.<sup>1</sup> Certain causes have been established that were previously unknown, and methods of prevention applied which had not previously been considered. Reference is made to this extension and development in order to indicate the value of the dust-explosion work.

### RECENT DUST - EXPLOSION LOSSES

Although for some time the natural tendency seemed to be to associate dust explosions with dust arising during the handling or milling of grain, investigations have shown that these explosions may occur in any type of representative industry where carbonaceous dusts are created during operating processes. In fact a number of disasters have occurred in recent years in industries in which they had not previously been experienced. In thirteen explosions 154 lives have been lost, more than 200 persons injured and property damaged in excess of \$16,250,000.

One of the so-called new kind of explosions occurred in the manufacture of lime sulphur insecticide in powdered form, in which a number of explosions occurred during the handling and collecting of the material. Explosions of aluminum dust, hard rubber dust, wood dust and similar industrial plant dusts have occurred accompanied by loss of life and considerable damage. Some of these explosions have been associated

\*Paper read at Millers National Federation Mass Convention, Kansas City, June 1, 1922.

<sup>1</sup>See article, "Engineering Problems in Dust Explosion Prevention," by David J. Price, CHEM. & MET. ENG., vol. 24, No. 1, Jan. 5, 1921.

with our method of handling and collecting dust, which has been quite an important recent development. It appears that certain material can be electrified during the process of collecting and handling and explosions originate in modern dust-collecting systems due to the ignition of the dust by sparks of static electricity. In fact, some recent explosions have indicated that electric sparks in the dust collector have been responsible for the primary dust ignition. This is a significant development, especially in view of the fact that dust was being collected by means of a suction fan instead of a blower fan, the former type of fan being generally considered preferable to the latter when considering the hazard or possibility of dust ignition by a spark within the fan.

#### CONTRIBUTION OF MINNEAPOLIS EXPLOSION TO DUST-EXPLOSION KNOWLEDGE

The Minneapolis explosion in 1878 made a significant contribution to our knowledge of dust explosions. The experiments of Professors Peck and Peckham of the University of Minnesota in connection with the coroner's inquest have been of very great value to investigators in recent years. In a lecture delivered June 1, 1878, at Association Hall, Minneapolis, Professor Peck demonstrated by a few simple experiments that all combustible material, when finely divided, forming a dust or powder would, under proper conditions, burn with explosive rapidity.

It is well recognized that the explosion resulted in the elimination of the old stive or dust room and led to the introduction of improved types of dust-collecting systems. The improvement in the method of dust collection in the flour-milling industry has been very marked indeed, with the result that today the average modern flour mill is maintained up to a high standard. This explains to a great degree the localizing or minor effect of these explosions when they do occur in flour mills. It is significant to note that the damage is much smaller than explosions from comparative causes in other branches of industry. The efficiency of the dust-collecting systems has made it possible to keep the mill clean and prevent the dust from collecting in dangerous quantities throughout different parts of the plant.

#### Comparison of Dust-Explosion Losses

##### FLOUR MILLS

Although the explosion in the Washburn-Crosby Mills, Minneapolis, on May 2, 1878, is referred to as the first dust explosion in this country, the records show that from 1860 to 1878 there were at least seven explosions in flour mills, principally of a minor nature, however. Five of these explosions were caused by the use of open-flame lanterns. The Minneapolis explosion resulted in the loss of eighteen lives and property damage to the extent of \$800,000, with the destruction of five separate mill buildings.

From 1878 to the present time records have been obtained of twenty-seven explosions in flour mills. Of this number the explosions at Cleveland, Ohio, in 1888, at Litchfield, Ill., in 1893, and at Portland, Ore., in 1909, stand out as the most prominent. These explosions since 1878 have been of limited proportions and have not caused as extensive damage as has occurred in other lines of industry. It is a safe statement, therefore, that the flour-milling industry has made more progress in dust-explosion control than any other representative industry, and considering the large number of flour

mills and the small number of explosions and the limited proportions, it must be recognized that this industry has made progress in connection with this problem. The explosion on March 15 in one of the modern flour mills in Kansas City has been thoroughly investigated by the Bureau of Chemistry and has confirmed the conclusion that when dust explosions occur in this industry both the extent of the explosion and the damage done are limited. It is the feeling of the engineers of the Bureau of Chemistry that the flour mills of the country are maintained on a very high standard and that the operating millers fully understand the problems of dust-explosion control and therefore adopt the necessary precautionary measures.

From 1860 to the present time the Department of Agriculture has record of thirty-five explosions in flour mills, and although figures are not available for the loss in all of these explosions, in thirteen cases it has amounted to \$2,537,000, an average of approximately \$181,000. The largest damage was in Minneapolis in 1878, amounting to \$800,000, with eighteen lives lost. It is significant to note that since 1878 there has not been a flour-mill explosion resulting in such extensive loss of life and property. The records indicate that only four lives have been lost and nine persons injured in flour-mill explosions since 1878. It is therefore well recognized that the necessary steps for dust-explosion control do not apply as much to flour milling as to some of the other grain-handling plants. The high standard in which flour mills are maintained, together with the efficient mechanical equipment, has made it possible for the industry to control the extent of these dust explosions and the resulting damage. The field of service in dust-explosion prevention lies among the other types of grain-handling plants and their methods of operation. It is hoped that the flour-milling industry will continue to maintain this control, and that the insurance companies will recognize the progress made.

##### GRAIN ELEVATORS

It is desired to contrast the increase in dust-explosion losses in other industries with the reduction in losses in the flour-milling industry. In considering grain elevators, we find that the first explosion of any importance reported to the department occurred in Toledo in 1898, 20 years after the Minneapolis explosion, with the loss of ten lives and injuries to five others. In Richford, Vt., 1908, ten years later, an explosion in an elevator caused the loss of seventeen lives and injuries to three others. Two women on the railroad track adjoining the plant were killed as a result of the explosion.

There have been thirty-six explosions reported as occurring in grain elevators since 1898. It is observed that up to 1916 the losses from explosions in grain elevators had been minor. During that year an explosion in an elevator in Peoria, Ill., caused a loss of \$600,000 and in the same year an explosion in an elevator at Baltimore caused the death of seven workmen, injuries to twenty-two others, and \$1,500,000 property damage.

In 1917 a large elevator in Brooklyn, N. Y., was destroyed by an explosion, with losses reaching to \$1,750,000 and the destruction of sufficient grain to feed 200,000 persons for an entire year. In 1919 the Canadian Government elevator at Port Colborne, Ont., was wrecked by a dust explosion causing the loss of ten lives, injuries to ten others and \$1,500,000 property damage. A month later, in September, 1919, an explosion in an elevator in Kansas City killed fourteen work-



men and injured ten others and destroyed property to the extent of \$500,000.

The most disastrous grain-elevator explosion on record occurred in the North Western Elevator operated by the Armour Grain Co., at South Chicago, Ill., March 19, 1921. All the workmen in the elevator at the time (six in number) were killed. The total damage approximated \$4,000,000. This amount was equally divided between grain loss and property damage.

In twenty-six explosions in grain elevators in which figures are available, the damage has amounted to \$11,722,555, an average of \$450,000 for every explosion. In seven of these explosions there have been sixty-seven lives lost and seventy-two persons injured.

The field of work in this problem lies in the development of preventive methods for dust-explosion control in grain elevators. The large scale of operation, the size of our plants, the large quantity of dust produced during the handling, elevating and storage of grain and the introduction of new ignition sources make necessary thorough investigations of this particular phase of dust-explosion control.

#### CEREAL AND FEED MILLS

One of the first explosions of any size reported as occurring in cereal and feed mills took place in Cedar Rapids, Iowa, in 1902. This was followed in 1905 by a similar explosion in the same plant causing \$1,000,000 property damage. In 1910 a Buffalo feed-grinding plant was wrecked by an explosion in which five lives were lost and seven workmen were injured. In 1913, which is really the epoch year in dust-explosion investigations (the year in which the present study began), an explosion in a feed-grinding plant in Buffalo resulted in the death of thirty-three workmen, injuries to eighty, and \$465,000 property damage. Probably one of the most damaging explosions in a feed-grinding plant occurred in Petersburg, Canada, in 1916, in which seventeen lives were lost, sixteen persons were injured and \$2,000,000 worth of property was destroyed.

The Department of Agriculture has obtained records of twenty-nine explosions in cereal and feed mills. In twenty-two of these explosions the loss has been \$4,959,600, an average of \$225,436. In seven of these explosions sixty lives have been lost and in ten explosions 128 persons were injured.

#### STARCH AND CORN PRODUCTS

In 1908, in Providence, R. I., a starch-dust explosion caused the loss of seven lives. In 1912 an explosion in a starch factory in Illinois resulted in the loss of fourteen lives and injuries to nineteen others. The most destructive dust explosion on record in this country occurred in Cedar Rapids, Iowa, in a starch factory in 1919. Forty-three lives were lost, thirty persons were injured and more than \$3,000,000 worth of property was damaged.

In seven of these starch-dust explosions, seventy-two lives were lost and eighty-nine persons were injured. The total money loss in ten has been about \$3,811,000.

#### MISCELLANEOUS EXPLOSIONS

In 1917 an explosion of pulverized sugar dust in New York caused the loss of twelve lives and twenty-four injuries and more than \$1,000,000 property damage. There are ten sugar dust explosions on record.

Violent explosions of chocolate and cocoa dust have also occurred. In one instance an explosion in a New England chocolate plant caused the loss of three lives

and \$750,000 property damage. Among miscellaneous explosions may be included explosions in rice mills, fertilizer plants, paper works, wood-working establishments and tanneries. In 1899 in Rhode Island an explosion of soapine dust resulted in the loss of two lives and injuries to nine persons. The department has investigated explosions of cork dust, spice dust, sulphur dust, powdered milk dust and many others. In 1920 an explosion of aluminum dust in connection with the manufacture of aluminum goods in a Wisconsin plant caused the death of six girls and injuries to six others. A few months later an explosion of hard rubber dust in Michigan caused the death of eight workmen and considerable property damage.

#### EUROPEAN EXPLOSIONS

Records have been obtained of twenty-four dust explosions in European countries. In eleven of these explosions ninety-one lives have been lost and more than 200 people injured. In an explosion in a meal mill in Liverpool in 1911, thirty-nine persons were killed and 101 injured. In 1908 in a sugar dust explosion in Paris, three workmen were killed and forty-nine injured.

#### TOTALS

A total of 242 dust explosions in industrial plants in the United States and foreign countries has been reported to the department. In fifty-two of these explosions, 379 lives have been lost and in sixty-nine of them 651 persons have been injured. The total money loss in 110 explosions in which figures are available has been approximately \$30,000,000, an average of more than \$270,000 for each explosion.

This does not include the losses in connection with the thresher explosions or cotton gin fires, and is confined entirely to the losses occurring from these dust explosions in industrial plants. In the Pacific Northwest thresher explosions and fires have resulted in approximately \$1,000,000 damage and the losses from cotton gin fires in the South have also been very great.

The results of the investigations of the Department of Agriculture from the time the work was initiated by the millers are about to be published in book form by the National Fire Protection Association.

#### GRAIN ELEVATORS AND THE DUST PROBLEM

Dust-explosion control has been brought about in representative industries by effective dust collection and removal. This has been possible in industries where the dust means commercial product with a market value. However, the matter as it relates to grain elevators in the United States and Canada needs special attention. We stand in the same position today in which we always have stood, so far as the dust-explosion problem relates to this type of grain-handling plant.

We cannot expect to control these explosions in grain elevators until some advancement similar to that made in flour milling, in so far as dust collecting is concerned, can be brought about. Mechanical methods of dust collection consisting of the necessary fans and piping systems are essential for dust control. It has been found on grain-threshing machines that dust-collecting fans remove the explosive smut dust and reduce the explosion hazard. The principle has been applied successfully on a commercial scale and now awaits application in grain elevators.

At the present time, existing commercial regulations

prohibit the installation of equipment of this kind in the grain elevators of the United States and Canada. These regulations are not based in any way on the explosion phase of the problem, but have to do with possible abuses leading to difficulty in checking weights, thereby affecting the shipper.

It appears that difficulty has always been experienced in maintaining the weights between shipper and receiver on grain entering the terminal markets. This has led, in some instances, to special provision whereby the grain elevator operator is prohibited from taking any steps which might in any way interfere with the weight of grain going into the plant.

Although these regulations were put into effect before science had determined that the dust was highly explosive, the application affects the proposition just the same. It is well recognized by the dust-explosion prevention engineers and the grain industry as a whole that it will be necessary for the dust to be removed effectively by mechanical systems before we can make the necessary progress. At the present time the dust escapes from the grain-handling equipment and settles on ledges, beams and girders throughout the plant. When the original ignition of dust occurs, there is sufficient concussion to shake this dust loose and propagate flame, resulting in a secondary explosion of large proportions. If the dust is effectively removed, of course the explosion is localized and the damage minor in extent, such as has been referred to in the explosions that have been occurring in flour mills.

#### DUST REMOVAL IN GRAIN ELEVATORS

This phase of the problem is possibly the most important one that the department is now called upon to study. The Canadian Government has appointed a representative committee, in co-operation with the Dominion Fire Protection Association, to co-operate with similar agencies in the United States to determine the practical possibilities of dust removal in grain-handling plants. The National Board of Fire Underwriters, in conjunction with the National Fire Protection Association, the National Safety Council and other representative agencies in this country, has recently appointed a similar committee for co-operation with the Canadian officials. The object and purpose of the committee will have to do with finding some uniform method of removing and controlling the dust in the grain elevators of both countries.

The Industrial Commission of Wisconsin has recognized the importance and necessity of this provision. Some months ago steps were taken to require the installation of exhaust systems in the grain elevators in the State of Wisconsin, particularly at points such as Milwaukee, Manitowoc and Superior. The request of the commission not being complied with, a conference was called in Madison, March 21, at which the operators were called upon to give the reason why the order of the commission had not been obeyed. It developed that although the grain operators were in hearty sympathy with the object and purposes of the commission and felt that this provision should be made, it would probably discriminate against Milwaukee as a terminal market. This was especially true if points such as Chicago, Minneapolis and other large grain-handling markets were not required to make similar provision. A general conference of all grain-handling states was suggested and is now in the course of consideration.

The Department of Agriculture has been called upon to co-operate and has already advised the commission that the department is in hearty sympathy with the plan and will give all possible help and assistance.

#### ADOPTION OF PREVENTIVE MEASURES

Is it going to require a series of disastrous dust explosions causing larger loss of life and extensive property damage before the importance of adopting effective preventive measures in grain elevators is fully appreciated? It has already been stated that 154 lives have been lost in recent dust explosions in industrial plants, with a large number injured and considerable property and foodstuffs destroyed. It appears, however, that it is only too true that we too often measure progress in safety by catastrophe. There is a difference in work of this nature between killing 154 people in thirteen explosions occurring in different parts of the United States and killing that number in one explosion. Unfortunately as a rule the interest in the subject is measured locally by the extent of life loss and damage by the explosion. Will it require a catastrophe such as the Iroquois Theater fire in Chicago or the Knickerbocker Theater disaster in Washington to concentrate attention on the importance of readjusting our commercial practices in so far as grain elevators are concerned?

We must regard the dust as explosive material such as dynamite, powder or gasoline and take the necessary steps for protection of life, foodstuffs and property. Are we ready for these steps, or must we wait for more explosions, accompanied by extensive loss of life?

#### CO-OPERATION BY FLOUR-MILLING INDUSTRY

We have endeavored in this brief paper to call attention to the very effective steps which have been taken by the flour-milling industry to control the dust-explosion hazard. We have also attempted to outline a future program in which it is hoped that the dust-explosion prevention work can be brought to the attention of the operators of grain elevators and other types of dusty industries in such a way that they may profit by the experience of the flour millers and reduce their explosion losses by adopting efficient methods of dust collection and removal.

The flour millers of the United States and Canada are in a position to render valuable assistance in this work and their co-operation is earnestly requested. Many mills are operated in connection with grain elevators or vice versa, and here the operators have an opportunity to see that the same precautions for the protection of life and property which have proved effective in the mill are adopted in the elevator. In business association an opportunity is also frequently offered for the careful operator to call to the attention of the negligent ones the saving which can be effected in both life and property by the adoption of effective dust-collecting and removal methods, and in this way render valuable assistance both to the industry and the country. The Department of Agriculture asks for a continuation of co-operation with the flour-milling industry in the efforts now being put forth to develop methods of prevention that will prove effective in reducing our dust-explosion losses. The interest in explosion control manifested by the industries has assisted in the adoption of effective precautionary measures developed by engineers in the Bureau of Chemistry. The results of recent investigations can be obtained upon request.



## Strength and Elasticity of Boiler Plate at Elevated Temperatures

Proportional Limit Maintained or Increased With First Temperature Rise — Tensile Strength Has a Slight Maximum at About 250 Deg. C., but Both Fall Off Badly at Higher Temperatures — Reduction and Elongation Have a Minimum at About 260 Deg. C., but Recover Their Original Value Around 450 Deg. C.

By H. J. FRENCH  
Physicist, Bureau of Standards

### PREVIOUS INVESTIGATIONS

IT HAS long been known that temperature above the ordinary atmosphere is accompanied by changes in steels, particularly in strength and ductility. A large number of interesting and important papers dealing with various phases of this subject have appeared from time to time, but our knowledge is still unsatisfactory and a better understanding of these changes will undoubtedly be of benefit to industry. Howe<sup>1</sup> long ago called attention to the apparent anomalies found in the effects of work at moderate temperatures upon the properties of wrought iron and steel used in boiler construction. Certainly from the standpoint of engineering design it is important to know how the proportional limit varies with changes in temperature, but unfortunately this is the most difficult to determine, and available data are conflicting.

In Fig. 1 is given a summary of results obtained in some of the more important published investigations of the tensile properties of wrought iron at high temperatures. Increase in strength with first rise in temperature above that of the room is reported by Huntington,<sup>2</sup> Epps and Jones,<sup>3</sup> while J. E. Howard<sup>4</sup> finds a slight decrease between about 50 and 150 deg. C. (125 and 300 deg. F.), which is followed by increase to a maximum between 205 and 345 deg. C. (400 and 600 deg. F.). In a very complete series of tests of steels of varying carbon contents Howard further found that the minimum tensile strength occurring with first rise in temperature was generally more quickly reached the lower the carbon content and that the higher carbon steels attained their maximum strength at lower temperatures than medium- or low-carbon alloys.

### ELASTIC PROPERTIES

Various investigators have from time to time reported decrease in elastic properties with increase in temperature. Epps and Jones obtained first a decrease then an increase at a slightly higher temperature, with maximum at about 180 deg. C.

In his tests Howard found that the interval between the elastic limit and the maximum stress showed particularly interesting features. Several of the different steels tested showed a yield point at the elastic limit, this period being marked by rapid stretching, which, once begun, continued under reduced loads. Such yielding rarely occurs in testing steel at room temperature,

but was observed by Howard up to about 260 deg. C. (500 deg. F.) in tests of mild steels and at temperatures somewhat below this in the higher carbon alloys. Bars tested between about 95 and 205 deg. C. (200 and 400 deg. F.) showed alternate periods of relaxation and rigidity under increasing stress resembling a succession of yield points apparently indicating some remarkable changes taking place within the metal in this temperature range.

There is more general agreement in various publications regarding changes in ductility as measured by elongation and reduction of area. Elongation decreases

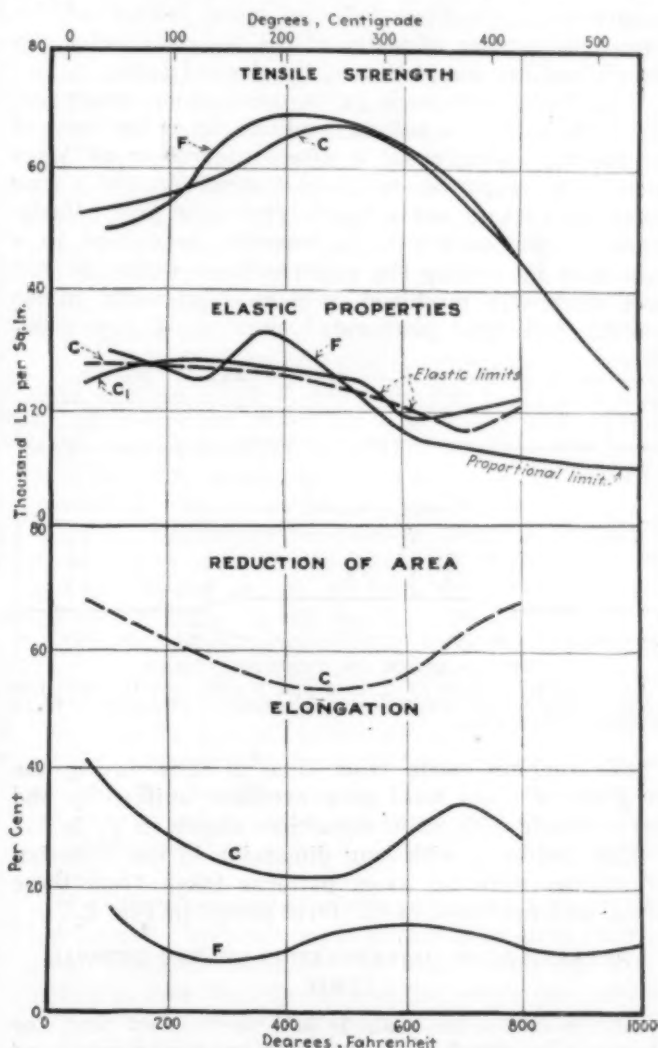


FIG. 1—TENSILE PROPERTIES OF WROUGHT IRON AND STEEL AT VARIOUS TEMPERATURES  
C, reported by Huntington for mild steel, C<sub>1</sub> for wrought iron, and F by Epps and Jones for wrought iron.

<sup>1</sup>Published by permission of the Director, Bureau of Standards.  
<sup>2</sup>"The Metallurgy of Steel," 1891.

<sup>3</sup>J. Inst. Metals, p. 126 (1912).

<sup>4</sup>MET. & CHEM. ENG., vol. 17, p. 67 (1917).

<sup>5</sup>Iron Age, vol. 45, p. 585 (1890).

slowly just above room temperature and thereafter more rapidly to a minimum variously reported as occurring between 125 and about 200 deg. C. (255 and 390 deg. F.). It then increases rapidly. Reduction of area likewise decreases but little just above the temperature of the room, but then drops rapidly to a minimum reported to occur between 200 and 300 deg. C. (390 and 570 deg. F.) and is followed by rapid increase in values. Howard also found a tendency for bars broken at temperatures between 205 and 315 deg. C. (400 and 600 deg. F.) to fracture in an oblique shearing direction.

#### STEELS TESTED

The steels tested in this investigation were received as half-inch boiler plates of firebox and marine grades. The specified tensile strength and composition for each are shown in Table I, but the third class listed showed

TABLE I—STEELS TESTED

Series	Grade	Specified Tensile Strength Lb. Per Sq. In.	Composition, Per Cent.			
			C	Mn	P	S
1	A. S. T. M. firebox*	52-62,000	0.19	0.43	0.020	0.031
2	Marine.....	60-70,000	0.25	0.38	0.019	0.031
3	Railway firebox.....	45-55,000	0.17	0.36	0.024	0.031
4	Railway firebox.....	45-55,000	0.18	0.43	0.017	0.035

\* American Society for Testing Materials firebox steel. Specification A30-18.

slightly higher tensile values than the limits prescribed and was supplemented by class 4. The former was, however, used and the tensile properties at high temperatures of the hot-rolled steel were determined, because the number of plates of the first two series was insufficient for completion of the desired tests.

The steels were made in the basic open hearth and the baths kept in a boiling condition up to the moment of casting. Such metal is often referred to as "open steel." It is porous in its cast condition and shows some segregation, but is nearly free from pipe. Variations in composition have, however, been kept to a minimum by cutting the patterns from which the test specimens were machined from steel originally in the central and least segregated portion of the ingot.

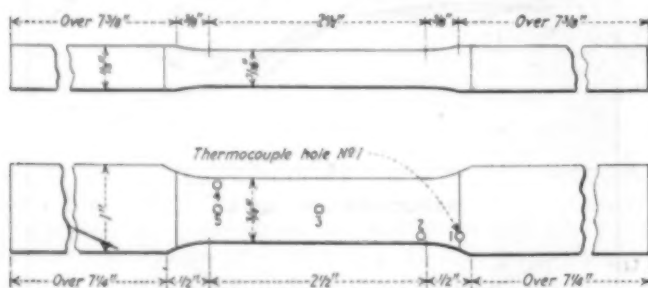


FIG. 2—FORM OF TEST-BAR USED

Small circles numbered 2, 3, 4 and 5 represent thermocouple holes drilled in one sample only, to explore uniformity of temperature distribution.

Check analyses made from time to time during the progress of these tests show excellent uniformity and agree closely with the compositions shown in Table I.

Flat test-bars, with long dimension in the direction of rolling, were cut from patterns taken from these plates and machined to the form shown in Fig. 2.

#### APPARATUS FOR DETERMINATION OF PROPORTIONAL LIMIT

At the outset emphasis is laid on the fact that, for the work required throughout the various sections of this investigation, suitable and readily manipulated apparatus and not the most accurate mechanism avail-

able was sought. The material under test is lacking in entire uniformity, so it appeared undesirable to erect elaborate equipment requiring a great deal more time in development and actual test.

The apparatus used in determination of the limit of proportionality at various temperatures is substantially as described by the writer in *CHEMICAL & METALLURGICAL ENGINEERING*, Jan. 19, 1921, vol. 24, p. 131, "Motion Pictures in Physical Testing Laboratory."

The smallest division on the instruments used was equal to 0.001 in., but estimated readings to the nearest 0.0001 in. were readily obtained.

#### HEATING FURNACE

The test specimens were heated by means of an electric tube furnace 11 in. long. For heating elements two spiral resistors in series were used. One covered the entire outer surface of the tube and the other was concentrated at the ends, the two requiring about 80 ft. of 22-gage nichrome wire. Yokes and major part of the 18-in. test-bar and rods were contained in the heating chamber. A comparatively small temperature gradient was obtained under suitable operating conditions, as the effective heating length during a determination was about 3 in. and located at the center of the tube length.

#### TEST PROCEDURE

The method of setting up the apparatus, together with procedure followed in actually carrying out the tests, was substantially as follows: A specimen was marked on one surface with a double-pointed center punch leaving marks 2 in. apart. Next yokes were attached to the specimen, fixing a setscrew into these impressions. Then, by lightly tapping the opposite side of the yoke, containing two screws, an impression of their exact location on the test-bar was obtained. These points were then enlarged by the use of the double-pointed center punch and the yokes carrying rods and frames were firmly attached to the test-piece.

The specimen was then passed up through the furnace until the rods appeared above the top, when the upper frame spanning the furnace was lowered into position and fastened to the rods. After the furnace was placed on a stand and the specimen was in the jaws of the testing machine, the dials were attached to the frame and adjusted to zero. The completely assembled apparatus is shown in the article in these columns referred to just above.

When thermal equilibrium at the desired temperature was reached, an initial load of about 1,500 lb. per sq.in. was applied, and the dials read or, as a matter of convenience, again set at zero. Readings were then taken at increments of 500 or 1,000 lb. actual load until the proportional limit was passed. The dials were then removed and the specimen was broken in the usual

TABLE II—TEMPERATURE SURVEY

Desired Temperature, Deg. C.	Temperature of Specimen at Positions Indicated in Fig. 2					Time After Couple No. 1 First Reached Desired Temperature, Minutes	Average Temperature Couples 2, 3, 4 and 5, Deg. C.	Maximum Temperature Variation, Deg. C.
	1	2	3	4	5			
165	165	173	167	158	165	15	166	15
	310	327	327	310	322	0	322	17
320	325	334	334	320	329	5	329	14
	325	336	334	318	332	20	330	16
400	402	415	412	393	402	10	405	22
	402	415	412	393	402	20	405	22



manner with a low rate of extension which approximated the intermittent increases of stress applied during determination of the limit of proportionality. Tests at each temperature were made in duplicate or triplicate and the proportional limit was obtained from a stress-strain diagram. Temperature was measured by a 22-gage standardized chromel-alumel couple connected to a Leeds & Northrup portable potentiometer. The end of the couple was inserted directly into a small hole drilled in the specimen at the fillet.

#### THERMAL EQUILIBRIUM

In order to obtain reliable and satisfactory results with the method described in the preceding paragraphs, thermal equilibrium must be reached prior to the start of the loading and maintained during the actual 8 to 15 minutes during which the test is being carried out. An adjustable resistance in series is used to balance the loss of heat from the furnace and specimen. The effect of temperature variations may be large unless care is taken to allow sufficient time for the specimen to become uniformly heated throughout after the potentiometer has once indicated the desired temperature. The dial readings will assist in determining when equilibrium has been reached and is being maintained.

Temperature determinations under actual test conditions made by placing thermocouple in holes located at various points in a specimen carrying entire auxiliary apparatus show that the position chosen for the single thermocouple (in the fillet) is representative of about the mean of the gradient throughout the gage length, where the temperature gradually decreased

from top to bottom (see Table II for partial reproduction of these variations). This variation is within 30 deg. C. (54 deg. F.) during the upper temperature ranges under consideration and does not exceed 20 deg. C. (36 deg. F.) at the lower temperatures used. However, as the thermocouple, specimen with auxiliary apparatus and furnace are in the same relative position in each test, the results obtained at various temperatures throughout the range 20 to 465 deg. C. (70 to 870 deg. F.) are comparable.

#### TENSILE PROPERTIES OF HOT-ROLLED BOILER PLATE AT ELEVATED TEMPERATURES

Tensile tests were made on the four grades listed in Table I. Results obtained are graphically represented in Fig. 3.

In all grades of plates increase in temperature above the ordinary atmospheric range is accompanied by distinct changes in strength and ductility, viz.:

(a) Tensile strength decreases a few thousand pounds per square inch in the neighborhood of 95 deg. C. (200 deg. F.). This is followed by a maximum which occurs at 290 deg. C. (550 deg. F.) in plates of the first three series and at about 250 deg. C. (480 deg. F.) in series 4, representing plates of lowest tensile strength. With further increase in temperature the strength decreases and again approximates ordinary atmospheric temperature values in the range 370 to 400 deg. C. (700 to 750 deg. F.).

(b) The limit of proportionality increases to a maximum in the neighborhood of 150 deg. C. (300 deg. F.). Firebox-grade increases more markedly and it is maintained to a higher temperature than marine plate. The latter has in effect constant proportional limit up to about 175 deg. C. (350 deg. F.). While such differences are noticeable at these relatively low temperatures, the proportional limit of the higher tensile strength marine plate is practically the same at 365 deg. C. (870 deg. F.) as that of series 1 and 3 firebox-grade plates and but slightly higher than that of the fourth series (railway firebox plate of lowest tensile strength).

(c) Only a slight decrease in elongation is observed until a temperature of about 95 deg. C. (200 deg. F.) is reached, above which the rate of decrease is much higher and a minimum is reached at about 245 deg. C. (470 deg. F.). Elongation then increases, but does not, throughout the range under consideration, reach the ordinary atmospheric temperature value in the marine plate (rated at 60,000 to 70,000 lb. tensile strength) and but slightly exceeds its room temperature value in the fourth series at 465 deg. C. (870 deg. F.).

(d) Reduction of area closely follows the inflections registered in the curves for elongation, but reaches a minimum at a slightly higher temperature except for the lowest tensile strength firebox plate, where the minimum occurs at practically the same temperature as that for elongation. At 465 deg. C. (870 deg. F.) reduction of area is greater than the value obtained at atmospheric temperature in each of the four series of plates tested.

It is to be noted that maximum tensile strength does not coincide with minimum reduction of area or maximum proportional limit, but examination of Fig. 3 indicates that the inflections in the curves for reduction of area are in general more nearly coincident with the reverse inflections in the curves for tensile strength and that elongation and proportional limit may be similarly paired.

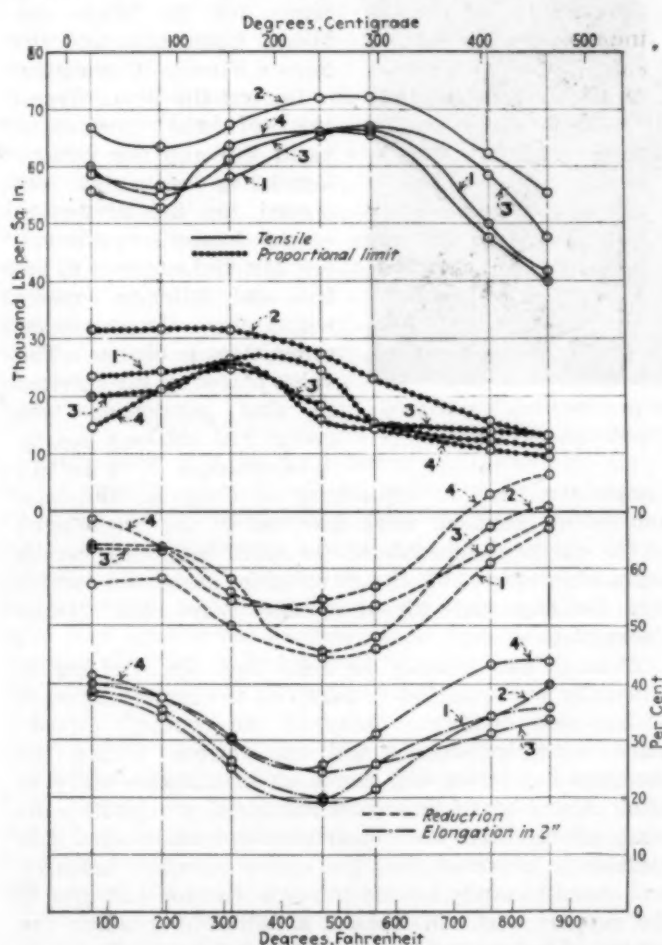


FIG. 3—TENSILE PROPERTIES OF FOUR GRADES OF BOILER PLATE MADE OF OPEN-HEARTH STEEL

## C. R. DeLong, Chief, Chemical Division, Department of Commerce

MORE than usual significance attaches to Secretary Hoover's recent announcement that a commodity division devoted exclusively to chemicals and related products is to be established within the organization of the Bureau of Foreign and Domestic Commerce. Ever since the bureau was reorganized on a commodity basis there has been an evident need for this recognition of the chemical and allied industries. The actual organizing of the chemical division has been delayed, however, due both to the lack of available funds and to an apparent unwillingness on the part of a small minority of the chemical industry to join with Secretary Hoover in his efforts to make the Department of Commerce an active, vital aid to industry.

Selecting a man to head this important division has not been an easy task for the department, but the recent news that the position has been offered to C. R. DeLong, chief of the chemical staff of the United States Tariff Commission, would appear to meet with the unanimous approval of the chemical industry. For a number of years Mr. DeLong has been very closely identified with, and in many cases largely responsible for, the Tariff Commission's excellent investigations and reports on the chemical industries. This work has given him an unusually broad knowledge of conditions in the domestic industry, particularly as it has been affected by the competition of the foreign manufacturers of chemicals. Experience of this sort cannot help but be of greatest assistance to him in analyzing the needs of the chemical industry and wisely interpreting them to the Bureau of Foreign and Domestic Commerce.

Carl Ray DeLong, who on Aug. 1 will assume his new duties as Chief of the Chemical Division, was born and educated in Ohio. He was graduated from the Ohio State University, Columbus, Ohio, in 1914, receiving the degree of Bachelor of Science in Chemical Engineering. After finishing his college training he was employed for a year and a half by the Ohio State Geological Survey and under the direction of Prof. James R. Withrow he completed a comprehensive survey of the industrial water supplies of Ohio. This work was followed by industrial experience in Kingsport, Tenn., in the manufacture of electrochemical products and dye intermediates. In 1917 this manufacturing experience led to a position with the Electron Chemical Co., of Portland, Me., where Mr. DeLong was engaged in research work on the commercial production of

acetic anhydride and certain related organic compounds. In January, 1918, when the U. S. Tariff Commission began its more intensive investigations in the chemical industry, Mr. DeLong was selected to carry on a responsible share of that work. His first duties were largely in connection with the so-called tariff information surveys, especially those dealing with heavy chemicals and electrochemical products. His report on "Barytes, Lithopone and the Barium-Chemical Industry" is an outstanding example of thorough investigation and the accumulation of data of value not only to the government but to the industry itself. Following the resignation of Dr. Grinnell Jones in 1920, Mr. DeLong was put in direct charge of all the investigational work of the chemical division of the commission. Under his direction a great many valu-

able reports of economic conditions within the different chemical industries have been prepared and published. Most widely known among these, perhaps, are the four editions of the *Census of Dyes and Coal-Tar Chemicals* (1917-1920), the *Tariff Information Surveys* on Schedule A (19 pamphlets) and on chemical products of the Free List (12 pamphlets), and the two editions of the *Summary of Tariff Information* prepared respectively for the Ways and Means Committee and the Senate Finance Committee.

During the actual framing of the permanent tariff bill and the various legislative measures designed for the protection of the domestic dye industry, Mr. DeLong was in active and intimate contact with the Congressional committees in charge. The value placed on his services in that connection was recognized not long ago by Congressman Nicholas

Longworth who, in explaining to Congress the vast amount of technical work involved in the preparation of the chemical schedule of the tariff bill, made public acknowledgement of the invaluable assistance which Mr. DeLong had given to the Ways and Means Committee.

Thus it may readily be seen that Mr. DeLong is unusually well qualified to carry on the important work of the new division. Many of the contacts already made with individuals and associations within the chemical industries will prove of inestimable value to him. A number of important industrial groups have already offered their whole-hearted co-operation—and it is confidently expected that the entire chemical industry will stand squarely behind the new division and give it the support that will make it a factor in speeding the return of prosperity to American business.

S. D. KIRKPATRICK.



Photo by Clinedinst, Washington.

C. R. DeLONG, CHIEF, CHEMICAL DIVISION



## Recovery of Glycerine From Spent Soap Lyes

Composition of Spent Soap Lyes—Removal of Impurities by Single and Double Treatments—Concentration of Purified Lyes in Single-Effect Evaporator Unit—Practical Data on the Equipment Required and Methods of Operating It to Obtain Maximum Efficiency

By WALTER E. SANGER  
Chemical Engineer, Chicago, Ill.

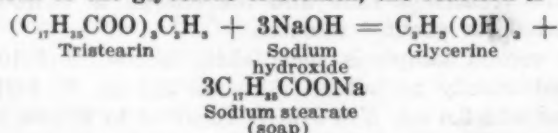
ALL true animal and vegetable fats and oils are combinations of glycerine and various organic acids. The most common of these compounds are stearin, olein and palmitin, which are combinations of glycerine with stearic acid, oleic acid and palmitic acid respectively.

Glycerine is obtained upon the saponification of a triglyceride, the chemical reaction being as follows:



In this equation, *M* stands for hydrogen or a mono-valent metal and *R* represents the alkyl radical of any fatty acid.

In soap-kettle practice, the fat or oil is usually saponified with caustic soda. Taking, then, the saponification of the glyceride tristearin, the reaction is



and it is thus seen that upon the saponification of a tri-glyceride with caustic soda there is produced glycerine and a sodium soap. Sodium soap is soluble in water, but is practically insoluble in brine.

After the glyceride is thoroughly saponified, sodium chloride is added to the charge in the kettle in order to separate the soap. The charge then separates into three layers—soap (which floats on the top of the charge), nigre (which remains suspended just below the soap and which is made up of soap, water and impurities) and spent soap lye (which settles to the bottom of the kettle and which contains most of the glycerine).

### COMPOSITION OF SPENT SOAP LYES

Spent soap lyes as they are drawn from the soap kettle consist, in general, of glycerine, salt, caustic soda, sodium carbonate, soap, fatty acids and water in addition to albuminous and oleaginous matter. The proportions of these ingredients vary considerably with kettle practice and also with the various stocks saponified. The most valuable ingredient is glycerine, the percentage of which will vary with the stock used and the amount of lye drawn from the kettle.

The first lye drawn from the kettle will contain the highest percentage of glycerine, while as many as thirty succeeding draw-offs will show glycerine on analysis. The amount of lye to be drawn from a kettle will depend on the price of glycerine. If lyes are removed with too low a glycerine content, the cost of recovery will exceed the value of the glycerine obtained.

The following results were obtained by the writer in a test saponifying about 30,000 lb. of tallow, containing 35.3 per cent of neutral fat:

	Weight, Lb.	Glycerol, Per Cent
1. Killing change .....	12,742	8.47
2. Rosin change .....	7,202	4.65
3. First wash .....	5,263	3.76
4. Second wash .....	3,787	3.30
5. Third wash .....	8,033	2.80
6. Fourth wash .....	7,202	2.36
7. Fifth wash .....	7,479	2.10
8. Sixth wash .....	8,033	1.96

### NECESSITY FOR REMOVAL OF IMPURITIES BEFORE EVAPORATION

Spent lyes are treated for the purpose of increasing the glycerol content of the crude glycerine obtained on evaporation. The most important impurities to be removed before evaporation are soap and fatty acids, together with the oleaginous and albuminous matter. For this purpose there is usually used a metallic salt such as sulphate of alumina,  $Al_2(SO_4)_3$ . Soap and some of the fatty acids combine with the salt to form an aluminum soap which is insoluble in water. Some of the salt forms aluminum hydroxide,  $Al(OH)_3$ , which apparently carries down oleaginous and albuminous matter together with some fatty acids mechanically.

### SPECIFICATIONS FOR SOAP LYE CRUDE GLYCERINE

The importance of proper treatment is seen on reference to the specifications for soap lye crude glycerine, which are as follows:

Analysis to be made in accordance with the International Standard Methods (I.S.M., 1911).

**Glycerol.** The standard shall be 80 per cent glycerol. Any crude glycerine tendered which tests 81 per cent glycerol or over shall be paid for at a pro rata increase, calculated as from the standard of 80 per cent. Any crude glycerine which tests under 80 per cent, but is 78 per cent or over, shall be subject to a reduction of one and one-half times the shortage calculated at pro rata price as from 80 per cent. If the test falls below 78 per cent, the buyer shall have the right of rejection.

**Ash.** The standard shall be 10 per cent. In the event of the percentage of ash exceeding 10 per cent, but not exceeding 10.5 per cent, a percentage deduction shall be made for the excess calculated as from 10 per cent at contract price, and if the percentage of ash exceeds 10.5 per cent, an additional percentage reduction shall be made equal to double the amount in excess of 10.5 per cent. If the amount of ash exceeds 11 per cent, the buyer shall have the right to reject the parcel.

**Organic Residue.** The standard shall be 3 per cent. A percentage deduction shall be made of three times the amount in excess of the standard of 3 per cent calculated at contract price. The buyer shall have the right to reject any parcel which tests over 3.75 per cent.

An untreated lye, on concentration, will yield a crude glycerine analyzing about 40 per cent glycerol. On reference to the penalties imposed as above outlined, it will be seen that at the present time crude glycerine obtained from an untreated lye has practically no mar-

ket value to the producer when he offers it for sale to glycerine refiners.

As much soap as possible should be removed from the lyes before they go to the lye treatment department. For this purpose there should be available enough storage capacity between the kettles and the lye treatment department so that the lyes may cool sufficiently to separate the soap. The usual practice is to have sufficient storage to hold the spent lye produced during any week.

#### LYE PURIFICATION BY SINGLE TREATMENT

The simplest and probably most common method of lye treatment is that known as the single treatment, which is herewith outlined in detail.

Cooled and settled lyes from which the soap has been skimmed are pumped to a treatment tank which is filled to about 24 in. from the top so as to allow space for agitation. After the proper amount of lye has been run in, preferably a steam blower or ejector is turned on for the double purpose of stirring the lye with air and at the same time heating it. After a few minutes of agitation, a sample is withdrawn before any metallic salt or acid is added.

Metallic salts commonly used are sulphate of alumina and ferric chloride. The former is usually purchased as such, while the latter is usually made by dissolving ferric oxide in muriatic acid.

Either 60 deg. sulphuric acid or 20 deg. muriatic acid may be used. Sulphuric acid is most commonly employed because of its lower cost, although it is objectionable on account of the formation of sulphates which have but little efficiency in separating the soap from water in the kettle. When the sodium chloride which is used for separating the soap from the water, etc., in the kettle contains about 25 per cent of sulphates, the separating or "graining" action is much impaired. If as much as 30 per cent of sulphates is present, it is very difficult to grain the soap.

For simplicity of discussion, we shall assume that sulphate of alumina and 60 deg. sulphuric acid are used.

After a sample has been withdrawn from the treatment tank, from 3 to 5 lb. of sulphate of alumina is added to the tank for each 1,000 lb. of spent lye. The amount to be added is usually determined by experience and will vary with various kettle practices and also with various stocks saponified.

#### CHEMICAL CONTROL OF TREATMENT

The sample of fresh lye is next filtered and tested. It is most convenient to make the test on 10 c.c. samples, using  $N/4$  NaOH and  $N/4$   $H_2SO_4$ , since 1 c.c. of standard solution is then equivalent to practically 0.1 per cent of acid or alkali (respectively) in the sample. Phenolphthalein is used as indicator, 1 g. being dissolved in 50 c.c. of alcohol and neutralized with caustic soda to form the stock solution.

We shall assume that the treatment tank is 8 ft. inside diameter and 8 ft. deep inside and that it is filled to a depth of 70 in. with spent lye. A tank of this diameter holds 261.4 lb. of water per inch of depth, so that 70 in. would weigh 18,298 lb. Spent lye is somewhat heavier than water, but calculations are made on water weights to avoid using an excess of materials and so that errors will be made on the correct side.

After adding three or four drops of indicator to a 10-c.c. sample of the filtered fresh lye,  $N/4$  acid is run in

from a burette until the pink color has been discharged and then an excess of about 4 c.c. is added to neutralize any carbonates or bicarbonates which may be present. Let us assume that the total amount of  $N/4$  acid added is 7.2 c.c. After boiling vigorously to expel carbon dioxide, the solution is cooled and the excess acid is titrated with the  $N/4$  NaOH until the sample remains pink on standing a short time. Assuming that 2.5 c.c. was required, the difference between 7.2 and 2.5, or 4.7 c.c., is the amount of  $N/4$  acid necessary to neutralize the alkali in the sample, or since each c.c. of  $N/4$  acid is equivalent to 0.1 per cent of alkali, the original spent lye contained 0.47 per cent of alkali.

In the treatment tank there is 18,298 lb. of spent lye testing 0.47 per cent alkaline or containing 0.47 per cent of NaOH; 18,298 times 0.0047 equals 86.0 lb. of NaOH which must be neutralized.

Assume that the lye under consideration required 3 lb. of sulphate of alumina for each 1,000 lb. of spent lye and that this salt was added *after* the first sample was taken.

Accordingly, 48 lb. of sulphate of alumina was added to the treatment tank after the first sample was taken.

This salt neutralizes about one-third of its weight of NaOH, therefore about 16 lb. of NaOH has been neutralized, leaving 70 lb. still to be neutralized. Since 1.57 lb. of 60 deg. sulphuric acid will neutralize 1 lb. of NaOH,  $70 \times 1.57$ , or 110 lb., of 60 deg.  $H_2SO_4$  is added to the treatment tank and the charge is thoroughly agitated for about 5 minutes.

A second sample is then taken, filtered, and 10 c.c. tested exactly as before. Assume 4.2 cc.  $N/4$   $H_2SO_4$  added and 3.6 c.c.  $N/4$  NaOH required to titrate back. The lye is still slightly alkaline—0.06 per cent—and since the original charge of 18,298 lb. has been increased by 95 lb.,  $18,393 \times 0.0006$ , or 11 lb., of NaOH still remains to be neutralized, requiring 17 lb. of 60 deg.  $H_2SO_4$ . This is added, the mixture thoroughly agitated for a few minutes and another sample taken, filtered and tested exactly as before. Assume readings of 4.7 and 4.6 c.c. for acid and alkali respectively. This indicates an alkalinity of 0.01 per cent, which is satisfactory. For normal operating conditions the limits are 0.01 per cent acid to 0.02 per cent alkaline.

#### CHECK ON COMPLETE PRECIPITATION OF IMPURITIES

Spent soap lye treatment is most efficient when all matter which can be precipitated has been separated in this form. As a further check on the treatment, three clear filtered samples are placed in separate test tubes. One sample is neutralized and there is added a drop or two of 10 per cent solution of sulphate of alumina. If sufficient of this salt has been added, the sample will not show a precipitate. If there is a precipitate formed, more salt should be added to the treatment tank. To the second sample there is added a slight excess of ammonium hydroxide and to the third sample a slight excess of dilute sulphuric acid. If the lye has been properly treated, there will be no precipitate formed in either of these two latter samples or else there will be formed the same amount of precipitate in both.

After the above tests have been made and the spent lye is found to be satisfactory, it is pumped through a filter press. Usually the first filtrate from the press runs cloudy (this is especially true if the lye is cold) and is returned to the treatment tank. After the lye



runs clear it is run to the evaporator feed tank, whence it is fed to the evaporator.

#### DOUBLE TREATMENT OF SPENT SOAP LYES

In the double treatment of spent soap lyes, the settled, cooled and skimmed lye is pumped to the treatment tank.

Sulphate of alumina is added to the first treatment tank, the amount being usually determined by experience with the general quality of lye produced. The charge is then stirred violently and warmed, if necessary, by any convenient means. Sulphuric acid (60 deg.) is slowly run into the tank so that the acid is neutralized almost as soon as it enters the tank.

An experienced operator can judge by the appearance of the lye when enough acid has been added. An inexperienced operator can test the charge from time to time by dipping a piece of blue litmus paper in the charge. After there has been added just sufficient acid to turn the blue litmus paper red, the charge is agitated for several minutes to insure thorough mixing and is then finally tested with litmus.

When the lye is in such condition that it just turns blue litmus, it is filtered into a second treatment tank, where caustic soda of any desired strength is added until a sample will just turn red litmus blue. A filtered sample of the lye is tested with a few drops of a 10 per cent solution of sulphate of alumina. If the sample becomes cloudy, more sulphate of alumina is added to the second treatment tank to precipitate everything which can be precipitated by this salt.

When the treatment is satisfactory, the lye is filtered through a press and is ready for evaporation. The caustic treated lye should never be filtered through a press which has in it any filter press cake from an acid filtration, as this would dissolve some of the precipitate obtained in the acid treatment.

The ideal condition of a spent lye for evaporation would be to have it in such condition that there is present sufficient acid to drive off all volatile fatty acids which can be boiled off in the evaporator. The objection to evaporating lyes in this condition is that

the corrosion on the evaporator would be excessive. If a spent soap lye is evaporated testing as high as 0.04 per cent acid, the corrosive action of the vapor is quite marked.

#### OTHER METHODS OF TREATMENT

The treatment of spent lye is by no means limited to the two methods here outlined. There are various other methods of treatment where there are used ferrous sulphate, calcium chloride, milk of lime, sodium carbonate, barium hydroxide, etc., besides treatment at various stages of concentration of the spent soap lye. These treatments are used to meet particular conditions in various factories and do not have a general application.

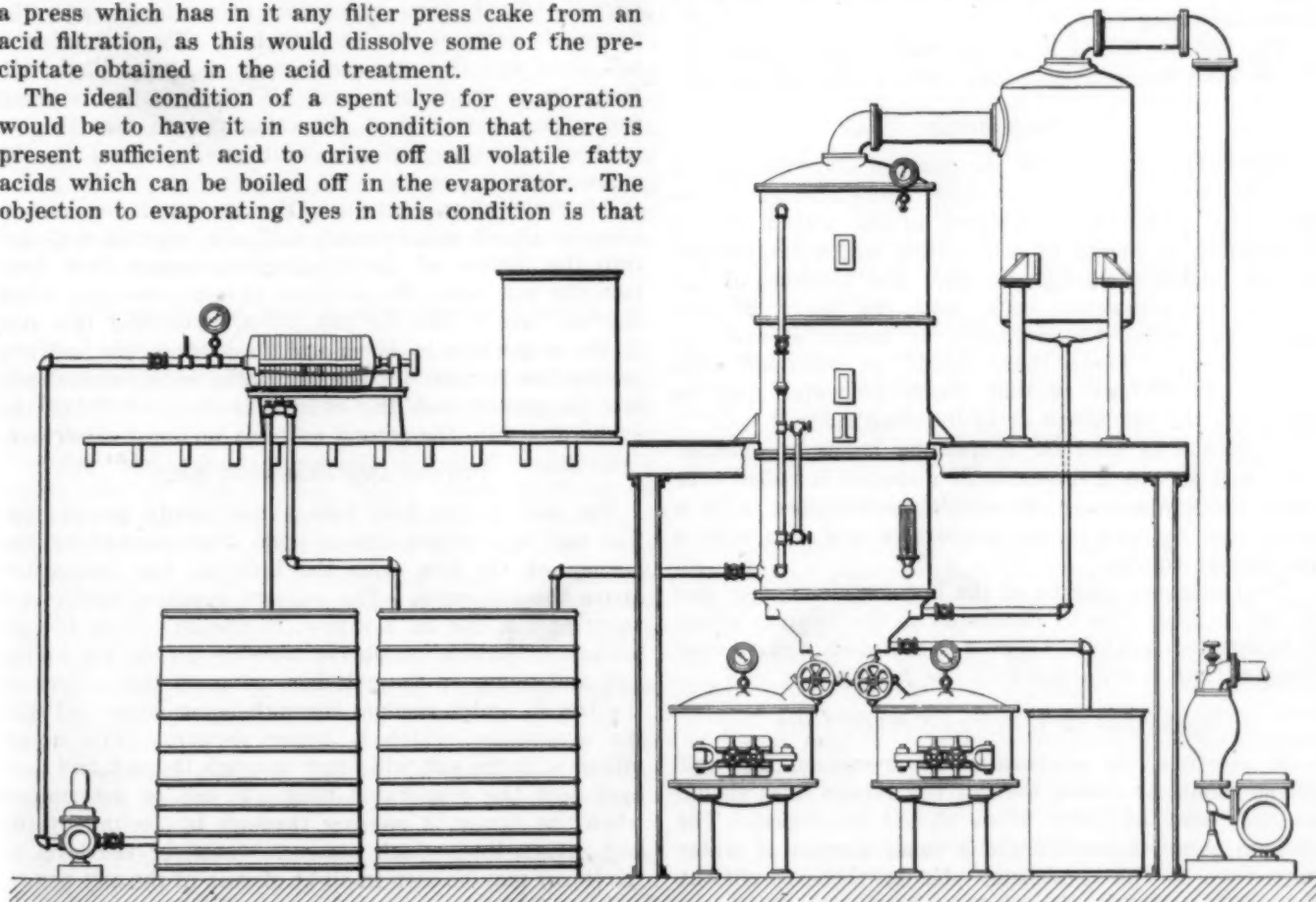
#### EVAPORATION OF PURIFIED LYES

The evaporation of spent soap lyes may be carried on in various types of equipment. Probably the simplest type is an open soap kettle equipped with closed coils, but, due to objectionable features, this method of evaporation is practically obsolete.

Evaporation is usually carried on under vacuum in single or double effect. A double-effect evaporator will require about one-half the steam necessary for a single effect of the same capacity and is frequently employed where large volumes of lye are handled. The single-effect evaporator is the type used by most soap works.

For purposes of this discussion we shall assume that evaporation is carried on in a single-effect evaporator, with two salt boxes.

Equipment comprising an evaporator unit consists of the evaporator, salt boxes, catchall, condenser,



EQUIPMENT FOR RECOVERY OF GLYCERINE FROM SPENT SOAP LYES

vacuum pump, vapor lines, liquor lines, instruments and gages.

The evaporator consists of the vapor belt, calandria or steam chest, cover and bottom. It should be equipped with a water-gage column, thermometer and vacuum gage, together with the necessary openings for liquor, steam and vapor pipe connections.

The vapor belt should be equipped with suitable deflector plates to aid in circulation and also to aid in the prevention of glycerine losses through entrainment. It should also have sight glass openings so that boiling of the liquor may be observed.

#### CALANDRIA

The calandria is usually of the standard vertical tube type. A common arrangement is to have copper tubes expanded into copper tube sheets, the body of the calandria being of cast iron. There has been considerable discussion about an electrolytic action being set up between the copper and the cast iron. The conditions for such an action are present, but the writer is acquainted with evaporators which have been in service for as long as 10 years wherein there is no perceptible deterioration due to such an electrolytic action and which appear to be good for an indefinite number of years of further service. The calandria should be so designed that there is free and positive circulation of the liquor in order that the tubes will not become salted. It should be equipped with baffle plates to aid the circulation of steam and to sweep out any non-condensable gases. It is further equipped with a steam inlet connection and condensation drain.

The cover may be equipped with a faced flange for vapor pipe connection or this connection may be taken from the vapor belt.

The bottom should be of the conical type tapped for liquor lines and with openings for drawing off the salt.

#### SALT BOXES

Salt boxes are used for the purpose of receiving the salt thrown out of solution upon concentration of the spent lye. They are connected to the bottom of the evaporator by means of salt valves, which are usually of the double wedge gate type. The bottoms of the boxes are connected back into the body of the evaporator above the calandria by means of salt box return lines. These lines should be equipped with valves and fittings so that steam or water may be passed to the salt boxes or to the evaporator.

A catchall is used for decreasing losses by entrainment and also as a separator if a charge is pulled over from the evaporator. It should be equipped with a drain line running to the evaporator and also with a water-gage column.

The condenser may be of the barometric type or else of the jet type directly connected to the vacuum pump. A barometric condenser serves to maintain a more even vacuum than is obtained with the jet type.

#### OPERATION OF A SINGLE-EFFECT UNIT

In starting the evaporator in operation, the salt valves should be closed, the salt box return lines should be open and all other lines should be closed. The vacuum pump is started and a small amount of water turned on to the condenser. Under these conditions vacuum is pulled on the whole system.

After the vacuum reaches 15 in. or is sufficiently

high to pull lye into the evaporator, it is filled to about one-half the height of the calandria. When the vacuum reaches 23 in. or more, a small amount of steam is turned into the calandria. Experience soon teaches just how much steam should be turned on. This should be done slowly enough so that boiling of the lye starts when the vacuum reaches about 25 in. Boiling should start slowly enough so that there is a drop in vacuum not to exceed 2 in. If the vacuum falls more than this, there is great danger of loss of liquor when the vacuum again rises, which it does quite rapidly as soon as the vapors reach the condensing water.

As soon as boiling commences, more water is turned into the condenser so that vacuum may be maintained. When the lye begins to boil, more steam is slowly turned into the calandria and more lye is fed to the evaporator to maintain a level about two-thirds of the height of the calandria. When the lye is boiling well the level in the evaporator is raised and the level of the liquor so maintained that the tubes are continually wet. Steam is increased until there is just a positive pressure on the condensation drain from the calandria. Under such conditions the evaporator is doing its normal work.

#### FILLING THE SALT BOXES

After a period depending on the salt content of the lye, salt will begin to crystallize out of the liquor and will drop into the bottom of the evaporator. The presence of salt may be detected in the liquor which is thrown against the sight glasses on the vapor belt. After salt begins to form the lye has no further value in dissolving salt remaining on the tubes from a previous run, as it is then a supersaturated salt solution, the salt valve on one salt box is opened, the steam is turned off of the evaporator momentarily and the charge is dropped into the salt box. The salt valve is left open and the evaporator body is again filled with fresh lye to the former level. While fresh lye is being fed, steam is turned on the calandria, so that the lye is heated to the boiling point as it is fed to the evaporator.

As evaporation continues, the lye again becomes a supersaturated salt solution and salt crystals will fall into the bottom of the evaporator, whence they drop into the salt box. Evaporation is continued and when the salt box is full the salt valve connecting this box to the evaporator is closed and the valve on the salt box return line is opened. The salt valve on the second salt box is opened and the charge is dropped from the evaporator into the second salt box as above described.

#### DRYING AND REMOVING SALT

The salt in the first box is now ready for drying. The salt box return line is open, thus connecting the bottom of the box with the body of the evaporator above the calandria. The vacuum breaker, which is a valve at the end of a nipple, is opened. This breaks vacuum or puts atmospheric pressure on the top of the salt and liquor in the salt box, whereas the bottom of the box is under vacuum through being connected into the evaporator which is under vacuum. The liquor mixed with the salt will draw through the salt and pass back into the evaporator body. It can be determined when the liquor is passing through by feeling of the salt return line, which becomes warm, or the level of the liquor may be seen in sight glasses in the salt box.

After the liquor starts to pass off from the salt box, the vacuum breaker is closed and steam is turned on



to the top of the salt. Enough steam is kept on to show a very low pressure on the box. After the liquor has all been drawn off into the evaporator body, steam is kept turned on for 15 to 30 minutes to dry the salt. When the salt is dry, steam is turned off and the valve on the salt box return line is closed. The salt box is now completely separated from the evaporator. The vacuum breaker is opened. The salt door is opened and the salt removed.

When the salt box is empty, the salt door is closed, and the valve on the salt box return line is opened very slowly to pull vacuum on the salt box so that it will be ready for dropping the next charge from the evaporator.

#### CONCENTRATING AND FINISHING

The operation of filling and emptying the salt boxes is repeated as often as necessary until the half-crude stage of glycerine is reached. The half-crude stage is readily recognized, because at this time, maintaining the same level in the evaporator and the same amount of steam on the calandria, both the vacuum on the equipment and the pressure on the calandria tend to rise quite markedly. Steam is then gradually reduced until there is about 5 lb. of pressure on the condensation drain with but little steam turned on the calandria.

With these conditions obtaining and with one salt valve open, the feed to the evaporator is shut off and the charge in the evaporator is concentrated until the liquor has a temperature of about 165 deg. F. under 26 in. of vacuum, or 170 deg. F. under 25 in. of vacuum. The salt valve is closed and the charge in the evaporator is not dropped again. The salt box is steamed as usual and the charge in the evaporator is concentrated until it has a temperature of 200 deg. F. under not less than 27 in. of vacuum.

If the spent lye has been properly treated, this finishing condition will produce a crude glycerine containing in excess of 80 per cent glycerol. Analyses of the crude produced should be made from time to time and the finishing temperature decreased if possible, as there is some loss of glycerine when finishing at 200 deg. Good crude glycerine has been obtained with a finishing temperature of 170 deg. F.

#### ADVANTAGES OF EVAPORATING UNDER VACUUM

Evaporation under vacuum is carried on primarily for the purpose of increasing the rate of evaporation and not for the saving of steam, as will be seen from the following:

Under atmospheric pressure, saturated steam has a total heat of 1150.4 B.t.u., while under 26.85 in. of vacuum it has a total heat of 1110.6 B.t.u. The difference in total heat is 39.8 B.t.u., or 3.46 per cent. The saving in heat units by evaporating under this vacuum is then 3.46 per cent, but against this saving there are the charges for steam consumed by the vacuum pump and also the condensing water required.

The advantages of evaporating spent lye under vacuum are primarily that to evaporate a given quantity of lye there is a saving in equipment and floor space required and also less loss of glycerine through being able to make crude glycerine at a lower temperature.

Rate of evaporation is approximately proportional to the difference in temperature between the heating medium and the medium being heated. Taking, then, the case of evaporating water on which accurate tempera-

ture figures are available,<sup>1</sup> assume the steam pressure on the calandria to be 5.3 lb., at which pressure the temperature of steam is 228 deg. F. Under atmospheric pressure the boiling point of water is 212 deg. F. and under 26.85 in. of vacuum the boiling point of water is 116 deg. F. Boiling under atmospheric pressure, the temperature drop would be 16 deg., whereas boiling under a vacuum of 26.85 in., the temperature drop would be 112 deg. F. Since the rate of evaporation is roughly proportional to the temperature drop, the rate of evaporation under the above vacuum would be about seven times as great as under atmospheric pressure.

#### NECESSITY FOR AVOIDING SUDDEN RISE IN VACUUM

Vacuum decreases the temperature at which a liquid will boil. In the case of water it will boil at a temperature as low as 32 deg. F. under perfect vacuum. This fact makes it very important that no sudden rise in vacuum take place in the evaporator.

If water is boiling in an evaporator under 20.04 in. of vacuum, its temperature is 161 deg. F. If the vacuum is 26.85 in., its boiling point is 116 deg. F. If there is present in the evaporator 2,000 lb. of water boiling under a vacuum of 20.04 in., the total number of B.t.u. present is 2,000 times 1129.9, or 2,259,800. The total amount of heat present in this amount of water under 26.85 in. of vacuum is 2,000 times 1110.6, or 2,221,200 B.t.u.

If the vacuum is suddenly increased from 20.04 in. to 26.85 in., water is present in the evaporator, which water has a boiling point of 116 deg. F. and the temperature of which is 161 deg. F. There is then available the difference between the two total heats, or 38,600 B.t.u., which energy very quickly expends itself in converting some of the water into steam. While the amount of steam generated with this excess of heat is only about 35 lb., yet this steam has a volume in excess of 6,000 cu.ft. which is generated suddenly throughout the 2,000 lb. of water and will mechanically carry over most of the water to a point beyond the evaporator. When the above conditions exist, the charge may be seen in the catchall, or if there is no efficient catchall, it may be seen in the discharge of the vacuum pump.

In a properly designed evaporator this is probably the most prolific source of glycerine losses. For this reason it is advisable to have all evaporators equipped with a recording gage (either thermometer or vacuum gage) so that there may be kept a check on how the evaporator is run for the full period of operation.

#### ENTRAINMENT LOSSES OF GLYCERINE

Entrainment losses of glycerine usually consist in the passing over of small particles of the solution being evaporated. These extremely fine drops may pass from the surface of the boiling liquor as such or may be the result of breaking up of larger drops by impingement or the breaking of bubbles. It can be demonstrated mathematically that comparatively large drops of liquor may be carried away with the vapors from the glycerine evaporator.

#### CAUSES AND REMEDIES FOR DECREASED RATE OF EVAPORATION

Decrease in the rate of evaporation of any given glycerine evaporator is most frequently due to the salt-

<sup>1</sup>Marks and Davis Steam Tables.

ing up of the tubes. This condition is largely a function of the design of the calandria and the salt content of the spent soap lye.

If there is a marked decrease in the rate of evaporation the manholes should be opened so that the calandria may be inspected. If the calandria is clean, the calandria and condensation drain should be tested under water pressure. If the calandria is salted, the manholes should be closed and the evaporator filled with water so that the calandria is completely immersed and this water boiled for about 15 minutes. It should then be drained into a storage tank so that the glycerine may be recovered. This water should be tested with a hydrometer and if it has a Baumé higher than 23 deg., it may be concluded that it is saturated with salt. A second charge of water should then be boiled and tested. If this second wash water tests less than 23 deg. Bé., this water should be run to waste. The manholes should be opened and the calandria examined to see if it is free from salt. It frequently happens that there is a small leakage in the steam valve on the calandria so that when the evaporator is shut down at night the salt deposit on the calandria and tubes is baked on very hard. Under these conditions, boiling with water for a short time will not dissolve all of the salt, so that the Baumé test may show the presence of only a small amount of salt in solution while the calandria is still coated. It is good practice to fill a glycerine evaporator with water when it is shut down for any considerable period of time. The necessity of doing this will vary in different soap works where different types of lye are handled and is a matter which can best be determined by experience.

The condensation drain of the evaporator should be equipped with a compound gage (pressure and vacuum) so that any leakage in the calandria may be easily detected. Small pinhole leaks usually can be located only by putting a water pressure test on the calandria.

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## Legal Notes

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BY WELLINGTON GUSTIN

### If Performance of Contract Is Impossible at Time Specified Both Parties Are Discharged

In *Edward Maurer Co., Inc., vs. Tubeless Tire Co.*, 272 Fed., 990, plaintiff sued to recover damages for the refusal of defendant to accept and pay for certain rubber yet undelivered upon two contracts. The first contract was made May 3, 1918, and the second May 14, 1918, both covering 45 tons of rubber, deliveries to be in equal monthly installments from May to December, 1918.

About 21,000 lb. of rubber was shipped in May and June, 1918, which was accepted and paid for by defendant. On Sept. 27, 1918, plaintiff shipped 11,204 lb. more, which defendant refused to accept and which was afterward returned to plaintiff and resold by it at a loss of 4c. per lb. No further deliveries were made.

When the contracts were made both parties knew the United States contemplated fixing a maximum price for rubber and restricting its importation from overseas and that such regulations might be announced at any time. On May 7 these regulations were promul-

gated, whereby plaintiff was not permitted to import any new rubber for delivery under these contracts unless defendant obtained an allocation certificate from the War Industries Board authorizing the defendant to buy and use it.

The allocation of rubber among manufacturers was made on the basis of their consumption of rubber during the preceding year, and inasmuch as defendant's plant was during that period in the construction and experimental stage, defendant was able to have allocated only 180 lb. a month. Plaintiff depended on importation of rubber and therefore since it could not import it could not deliver to defendant. These restrictions were lifted Dec. 13, 1918, and by April, 1919, plaintiff had imported rubber and was then in a position to make further deliveries. Formal tender of delivery was made in June, 1919, and acceptance was then refused. At this time the price of rubber was 40c. per lb.—that is, 22c. less than the contract price. Suit was then brought to recover damages, measured by this difference between market price at time of tender and the contract price.

Plaintiff contended that these contracts, properly construed, merely postponed or suspended delivery during the period that performance was prevented by governmental interference and that when the restrictions were removed the contract remained in full force and effect, with an obligation upon the plaintiff thereafter to deliver, and upon the defendant to accept and pay. By provision in the contract it was "subject to all the rules and regulations imposed by the United States Government."

#### GOVERNMENT REGULATIONS VOIDED CONTRACT

The court said plaintiff's contention could not be sustained, since the contract in its entirety was made subject to the rules and regulations imposed by the United States Government. It is not deliveries only, but the contract obligation itself, which is made to depend upon these conditions.

Again the court points out that in contracts to deliver and to accept and pay for an article of commerce, the market value of which is fluctuating, time is an essential element. The failure or refusal of the seller to deliver or tender the monthly quantities at the time is a breach which would discharge the buyer from further obligation to accept and pay. The buyer of an article thus fluctuating in value cannot be held to an obligation to accept and pay at other times and under different conditions when its market value may have greatly changed.

The rule of law applicable is that if performance of the contract is made impossible by a subsequent valid act of law or governmental authority, both parties are discharged. If a contract is made subject in its entirety to a condition, and that condition happens, the rule is that both parties are discharged, and not that performance is suspended until the condition is overcome. The court says that neither party could have in mind merely a suspension or postponement of delivery during the war or while governmental regulations were in force, because no one could then foresee how long the war would continue, nor anticipate market or manufacturing conditions at the end of the war and after the restrictions were lifted. It would require clear and apt language in a contract before a court would be justified in finding such to be the intent of the contracting parties. Therefore the federal District Court gave judgment for the defendant.



## Some Economic Aspects of Ammonia Oxidation\*

Cost of Concentrating Weak Nitric Acid Produced by Ammonia Oxidation at Present More Than Offsets Advantages Due to Lower Conversion and Nitrogen Costs — An Economic Study of the Factors That Determine When Ammonia Can Profitably Replace Saltpeter as a Source of Nitric Acid

By GUY B. TAYLOR

Experimental Station, E. I. du Pont de Nemours & Co.

IF THE primary product obtained by oxidizing ammonia were strong nitric acid, then ammonia on a price parity basis with Chilean saltpeter would be incomparably cheaper than saltpeter as a source for nitric acid. Unfortunately the primary product is nitric oxide and the cost of conversion of this oxide of nitrogen into strong nitric acid is considerable, in spite of the fact that the raw materials, water and air, required for doing so, cost practically nothing. The industrial uses for weak nitric acid are so limited in extent that the oxidation of ammonia for the production of weak acid is of minor interest in the discussion. The question, then, of when it is economical to oxidize ammonia and when not to oxidize ammonia centers largely around the question of the cost of concentrating nitric acid. This state of affairs will continue as long as a small price differential exists between Chilean saltpeter nitrogen and ammonia nitrogen. With the development of processes for synthetic-ammonia manufacture, the price differential is likely to change in favor of ammonia and the relative importance of nitric-acid concentration will vary as a factor in the situation.

The next most important factor, after raw materials cost and concentration cost, is the scale upon which manufacture is conducted. Nitric acid is an extremely corrosive liquid and on this account its transport is difficult and expensive. As a consequence nearly all large users manufacture at the place of consumption. Ammonia oxidation plants are not inexpensive to build and the first cost per ton of rated capacity is naturally greater the smaller the output. It might pay to construct a new plant to produce nitric acid by oxidizing ammonia, while under a similar set of circumstances it would not pay to scrap a going retort process.

### COMPARISON OF EQUIPMENT AND MANUFACTURING PROCESSES

Before proceeding to more detailed comparisons, it is advisable to outline briefly the character of the plants required for the two processes. The essential units in the equipment are:

- | Ammonia Oxidation             | Chilean Saltpeter            |
|-------------------------------|------------------------------|
| 1. Ammonia liquor storage.    | 1. Soda storage.             |
| 2. Ammonia gas plant.         | 2. Sulphuric acid storage.   |
| 3. Ammonia converters.        | 3. Retorts.                  |
| 4. Absorption system.         | 4. Condensers and receivers. |
| 5. Nitric acid concentration. | 5. Absorption system.        |

In the ammonia-oxidation plant ammonia gas is distilled from liquor and mixed with air. The gas mixture is then put through a catalyst in the converter whereby nitric oxide and water vapor are produced. The gas then passes to the absorption system, where, coming in

contact with water and air, the nitrogen oxides are converted to weak nitric acid with a strength of about 50 per cent. This weak acid is converted to 90+ per cent  $\text{HNO}_3$  by distillation from sulphuric acid. This results in the production of weak sulphuric acid, from which the water must be boiled out in order that it may be used again.

In the saltpeter process sodium nitrate and sulphuric acid are charged into cast-iron retorts and strong nitric acid is distilled out and condensed. Toward the end of the distillation the distillate weakens somewhat due to thermal decomposition of  $\text{HNO}_3$  and the release of water from the charge, previously held by the sulphuric acid. This weaker distillate is in some cases caught in a separate receiver and in others mixed with the strong distillate. Some nitrogen peroxide is evolved and recovered as dilute acid in the absorption system. The dilute absorption system acid and the weak distillate together seldom amount to more than 10 per cent of the yield.

In the ammonia-oxidation process all of the output is recovered first as dilute acid, which must be concentrated, while in the saltpeter or retort process upward of 90 per cent of the output is directly recovered as strong acid. On the other hand, the retort process consumes sulphuric acid in about equal tonnage with Chilean saltpeter and the ammonia-oxidation process consumes none.<sup>1</sup>

### FIXED CHARGES—CONSTRUCTION AND OPERATION

As a basis of comparing the two processes let us take a case favorable to ammonia oxidation. Let us assume that a new plant for nitric-acid manufacture is to be built in a locality favorable to large-scale production, say a place where 25,000 tons of  $\text{HNO}_3$  per year can be disposed of. This is a convenient capacity rating to assume, because it approaches the largest conceivable peace-time production in any one place and because a plant of this size was actually built in this country during the war (U. S. Nitrate Plant No. 1). This gives us a line on probable plant cost. Such a plant will cost, say, \$1,000,000, or \$40 per ton-year. The first cost of a retort plant on this scale will amount to, let us say, \$12 per ton-year, or less than one-third as much. The cost of operating the two plants will vary from time to time, but our estimate is that this cost will average about the same for each—that is, \$10 per ton of product figured as 100 per cent  $\text{HNO}_3$ . This item, hereafter designated "operating cost," includes operating labor, repair labor, repair material and replacement, fuel and power, and superintendence. In the case of the ammonia-oxidation process the operat-

\*A paper presented before the Acid Symposium at the fourteenth semi-annual meeting of the American Institute of Chemical Engineers, Niagara Falls, Canada, June 19 to 22, 1922.

<sup>1</sup>Except the small quantity lost in repeated reconcentration of sulphuric acid required for dehydrating weak nitric acid.

ing cost of the concentration unit is excluded. The retort process requires about 1.4 tons of sulphuric acid per ton  $\text{HNO}_3$ . If this acid costs \$16 per ton, the sulphuric acid cost per ton of  $\text{HNO}_3$  will be about \$20, making due allowance for niter cake credit.

In order to eliminate what may be termed the minor variables in the problem, let us assume the cost factors arrived at above are constants and study the major variables—nitrogen costs, yields and concentration costs. The assumed constants may then be summed up as follows and the sum designated "conversion cost":

	Ammonia Oxidation (As 50 Per Cent Acid)	Chilean Saltpeter (As 90+ Per Cent Acid)
Operating cost.....	\$10	\$10
Fixed charges at 15 per cent <sup>a</sup> .....	6	2
Sulphuric acid.....	0	20
Conversion cost, per ton of $\text{HNO}_3$ .....	\$16	\$32

#### NITROGEN COSTS

In the chart shown in Fig. 1 the relations between the nitrogen costs of the raw materials and the finished product for various conversion efficiencies are presented graphically. The ordinate shows the costs of ammonia and sodium nitrate at parity in cents per pound and the

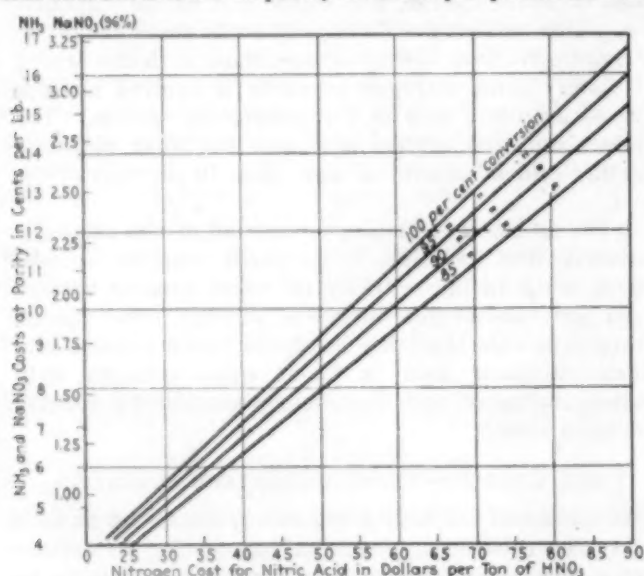


FIG. 1—NITROGEN COST OF NITRIC ACID VS. THE COST OF AMMONIA AND SODIUM NITRATE FOR VARIOUS CONVERSION EFFICIENCIES

abscissa the corresponding nitrogen cost for nitric acid in dollars per ton of  $\text{HNO}_3$  at various conversion efficiencies. The nitrate is figured as 96 per cent pure.

The yield from nitrate may be conservatively put at 98 per cent and that from ammonia at 90 per cent (95 per cent oxidation efficiency and 95 per cent absorption efficiency). At these yields, with ammonia and nitrate at parity, and varying in price from 8c. to 15c. for  $\text{NH}_3$  and 1.5c. to 2.9c. for nitrate, the total cost for nitric acid from ammonia varies from \$64 to \$106 per ton and for nitrate from \$76 to \$115 per ton. The spread between the two processes is only \$12 at the lower nitrogen cost and \$9 at the higher. That is to say, if 50 per cent nitric acid can be concentrated for much less than \$10 per ton, it pays to oxidize ammonia when ammonia and nitrate costs are on a parity basis.

<sup>a</sup>Includes the items of taxes, insurance, interest, amortization and obsolescence.

The following tabulation gives a few examples of the spread between the two processes when nitrogen costs are not on a parity basis:

Cost of $\text{NH}_3$ Per Lb.	Cost of $\text{NaNO}_3$ Per Lb.	Ammonia Oxidation Cost of $\text{HNO}_3$ Per Ton (50 Per Cent)	Chilean Saltpeter Cost of $\text{HNO}_3$ Per Ton (90+ Per Cent)
8c.	1.75c.	\$64	\$82
10	2.25	76	97
12	2.50	88	103
12 5	2.25	91	97

The first three cases in the above tabulation are taken at prices showing not unusual disparities in price quotations between ammonia and nitrate, and in favor of ammonia. In the last case, ammonia is relatively the higher priced and is about the condition of affairs that obtained in the early months of this year. From the above it will be observed that ammonia as a source of weak nitric acid is cheaper than saltpeter at any disparity in nitrogen cost that is likely to occur.

It is doubtful whether the overall yield of an ammonia-oxidation plant can ever closely approach the efficiency of the retort process, which in well-conducted works averages 98 to 99 per cent. The catalytic oxidation efficiency to be expected under the best conditions can scarcely be more than 95 per cent and absorption efficiency 98 per cent, or an overall of 93 per cent. On a nitrogen parity, then, nitrogen for the ammonia-oxidation plant must always cost more, but this is more than balanced by sulphuric acid used in the retort process. As a matter of fact, based on prices in normal years, the nitrogen costs of the two processes would have been about the same in the past, because ammonia commanded a less price per pound of nitrogen than did nitrate. The thing to be emphasized in considering yield is the relative importance of yield gains to any probable operating economies. An addition of 1 per cent to the yield means more in dollars and cents than a reduction of 10 per cent in operation cost or fixed charges.

#### COSTS OF CONCENTRATION

The concentration cost, the most important item under present conditions militating against any widespread adoption of ammonia oxidation, is a difficult matter to estimate. Nitric acid has never been concentrated in this country on the scale assumed in our comparisons, except under war conditions. The cost of this operation will probably lie between \$20 and \$40 per ton of  $\text{HNO}_3$ . Assuming that it can be done for the lower figure, what price can we afford to pay for ammonia in order to compete with Chilean saltpeter? In the following tabulation the first column shows an assumed price for saltpeter, the second column the corresponding cost of ammonia at parity, the third column the price to which ammonia would have to fall to break even with saltpeter, and the fourth the estimated cost of nitric acid at the break-even condition. Yield from nitrate is taken at 98 per cent and from ammonia at 90 per cent. The conversion cost of ammonia is taken at \$16 and of nitrate \$32 per ton  $\text{HNO}_3$ ; \$20 is added to the ammonia-oxidation process for concentration.

Cost of Chilean Saltpeter, Cents Per Lb.	Cost of Ammonia— At Parity, Competing Price, Cents Per Lb.		Cost of $\text{HNO}_3$ Dollars Per Ton
2.0	10.5	8.8	89.00
2.5	13.0	11.2	103.50
3.0	15.6	13.7	118.00



The above tabulation shows that ammonia must be obtainable for at least 2c. per lb. less than the parity price in order to show any considerable saving over Chilean saltpeter at 2c. to 3c. per lb. as a source for strong nitric acid.

The catalytic oxidation of ammonia gas to nitric oxide—that is, the ammonia-conversion step in the process—may be considered as in a very satisfactory state. Obviously, from what has been said above, the point of attack in improving the process is to solve the problem of more cheaply converting nitrogen oxides to concentrated nitric acid. Seventy per cent of the plant cost is swallowed up in huge absorption towers recovering weak acid. And this weak acid must be concentrated. This problem in connection with the arc process, in which these features are greatly magnified, has received much attention abroad, as witnessed by an extensive patent literature. But not one of these proposals looks promising even on paper, and needless to say none has ever reached the commercial stage of development.

#### CONCLUSIONS

All things considered, it may be concluded as a result of this study that under present conditions, as a source for strong nitric acid, saltpeter has a slight advantage over ammonia. The conversion cost and the nitrogen cost (usually) of ammonia are less than corresponding costs of sodium nitrate, but this advantage is more than offset by the necessity for concentrating nitric acid in the ammonia process. The advantage of the retort process probably increases as the scale of manufacture decreases. If the price of ammonia falls, as is likely with the coming into production of synthetic-ammonia plants on a large scale, then the slight advantage of the retort process will disappear. It is conceivable that the time may come when it will no longer pay to import Chilean saltpeter at all as a source of nitric acid.\*

There are two uses for which ammonia oxidation may be profitably employed immediately. In the writer's opinion all lead chamber or "nitration" sulphuric acid plants should be equipped with ammonia converters. In this case the plant investment is relatively small. The nitrogen oxides are used as such, no absorption system of any kind being needed. The ease of control and uniformity of supply ought to be of considerable advantage to the sulphuric acid plant operation. The second possible immediate use for ammonia oxidation is for the production of weak nitric acid. There are a few industries utilizing weak acid having no use for strong acid. If the requirements are sufficiently large, it would pay to oxidize ammonia.

#### Hydro-electric Development in Italy

Hydro-electric power in Italy as of Jan. 1, 1922, is reported by Consul Sycks, Turin, as 1,191,797 hp. In addition to the hydro-electric plants now in operation, new ones are in course of construction, of which those in Lombardy will produce 121,934 hp. and those nearing completion in Piedmont will produce 109,386 hp. The total electric power now generated by the hydro-electric plants (1,191,797 hp.) is estimated at 60 per cent of the capacity of the total number of centrals for which concessions have been granted.

\*In this connection it should be remembered that the export duty on Chilean saltpeter from Chile is a considerable fraction of its total cost. This tax will no doubt be reduced to meet competition with ammonia, should the market for saltpeter be seriously threatened.

### The Application of Chemical Research to the Cotton Oil Industry\*

BY DAVID WESSON

Technical Director, Southern Cotton Oil Co.

During the past forty years accumulated experience aided by scientific research has brought about enormous changes in the milling of cotton seed and the refining of cottonseed oil. A knowledge of the fundamental principles of refining and hydrogenation has replaced the irregular evil-flavored oils of the early days with tasteless, odorless products which have taken much of the prestige from the oil of the olive and the fat of the hog.

Although much has been learned, let us not for a moment imagine that there are no new fields to conquer. We should know the breeds of cotton producing the seed which will carry the longest fibers and at the same time yield the most oil. We know that cake and meal are rich in protein, but we know comparatively little about the protein itself. Cottonseed oil has been bleached for the last forty years with fullers earth. How much do we know about why the earth does the bleaching and what is its effect on the oil itself? What is the nature of the color removed by the earth? How much do we know about the various mixed glycerides produced at different stages of the hydrogenation process? We know that all fats turn rancid, but we know very little about the causes and the products formed in the process. This is a matter of great practical importance.

In buying and selling crude oil our transactions are governed by a rule-of-thumb test which, in a way, approximates the time-honored but barbarous means employed in the refining kettle.

One of the most promising signs for the future is the spirit of the Department of Agriculture, which has started in on a fundamental research primarily to benefit the farmer, but incidentally of great use to the vegetable oil industry.

It seems to me that the time is ripe for co-operative research for the good of the industry as a whole. The day has gone by when there is anything to be gained by a lot of technical men getting together and all keeping their mouths shut for fear they might tell something that would be of use to the other fellow. A free interchange of ideas will, in my opinion, do more good to the industry as a whole than the past practice of silence and secrecy. There should be free converse about the chemical nature and the constitution of the materials which we all handle, but when it comes to the details of erecting and operating plants to obtain certain results, then we are treading on dangerous ground, and it is only right and proper to maintain secrecy.

#### Revised List of Research Chemicals

The National Research Council has issued a new edition of its circular "American Research Chemicals" giving a more complete listing of the companies manufacturing research chemicals, biological stains and indicators, vital stains and hydrogen ion indicators. This list gives for each chemical the names of the companies which have reported to the committee that they are manufacturing that product. In a few cases distributors are also listed. A copy of the list can be obtained on application to C. J. West, National Research Council, Washington.

\*Extracts from an address before the thirteenth convention of the American Oil Chemists Society, New Orleans, June 5 and 6, 1922.

## Fire Hazards at Quenching Tanks

**A**N IMPORTANT report from the committee on manufacturing risks and special hazards was considered at the May meeting of the National Fire Protection Association, on the "Regulations for Use of Volatiles in Manufacturing Processes." In introducing its report the committee states:

The use of dip tanks containing highly flammable compounds subject to flashing at ordinary temperatures and giving off flammable vapors and possibly vapors forming explosive mixtures presents a severe fire hazard. Manufacturing requirements in some industries, the automobile industry for example, involve extremely large tanks, there being often three or four of them in a single room, each having a capacity of possibly 10,000 gal. The mixtures found in dip tanks may include various amounts of naphtha, benzene, benzene, amyl acetate, bisulphide of carbon, alcohol, which represent the principal flammable liquids. Of a slightly less hazardous nature are tanks containing paints, turpentine, kerosene, heated asphaltum, paraffine and tempering oils. Tanks containing mixtures with more or less benzene and naphtha represent a large majority of those in use.

Samples of air taken from dip and quenching rooms seldom show a content of volatile hydrocarbons which approach the point where danger from explosion exists. However, it is essential that means be provided to prevent the accumulation of heavy vapors at low points in the room; for somewhere between the rich, low-lying mixtures and the lean upper layers is an exact proportion which will explode from a small spark or flame. Furthermore, ventilation should be directed to the outside air; otherwise dangerous concentrations will occur in passageways leading to other rooms which act as ventilating corridors.

### DIPPING ROOM FIRES DIFFICULT TO EXTINGUISH

The fire hazard in dipping rooms is extreme in any case, as the nature of the compounds in the dip tanks is such that a fire in them produces serious results. Ordinary methods of extinguishment cannot often be applied with success to such a fire. Even if the room is fire resistive and contains no other combustibles, the heat from the burning compounds will ordinarily cause a severe loss to the most superior construction and even complete destruction has sometimes occurred. Such a fire will distort, with large loss, unprotected steel work and machinery in the room, as well as cause a heavy damage to the other contents.

Moreover, a dip tank on fire will burn for a very long time because a sufficient amount of air cannot get to the limited surface to consume the contents quickly. A tank containing an ordinary mixture, 2 ft. deep, would probably burn fiercely for 2 or 3 hours. The only way to extinguish such a fire is to smother it promptly. If too much water is applied to the tanks they will overflow and the burning volatiles will flow around the room wherever the water carrying the burning liquid on its surface may run, thereby spreading the fire. Provision for the safe disposal of the liquids is essential where water is likely to be used.

### HOSE STREAMS SPREAD FIRE

The use of hose streams in rooms containing uncovered and unsecured tanks on fire has resulted in serious losses through the displacement of the burning liquids by the water, the heavy streams often splashing the liquid about the room and upsetting the containers. Too much care cannot be taken in using hose lines on such fires. There are a great many cases

in the fire record where the light spray from the sprinklers has extinguished fires in open dip tanks, which effect has been largely due to the cooling power of the sprinkler spray, but even with sprinklers there is a danger of seriously overflowing the tanks. If hose streams are used, effort should be made to spray the water and confine work to cooling the building until the contents of the tanks burn.

### REGULATIONS RECOMMENDED

Section 4, on quenching tanks, proceeds:

Where a continuous process tempering machine is used, pumps or other means shall be provided for circulating the oil from the tempering tank to the cooling tank, sufficient pumping capacity and the relations of the speed of the machinery to be so adjusted as to prevent the oil rising to a temperature dangerously near its flash point. An automatic cooling or refrigerating system arranged to regulate the temperature of the oil exactly is preferred. Automatic machines feeding hot parts to the oil preferably should be so arranged that they will stop automatically through the operation of a thermostat placed in the oil when dangerous temperatures are reached.

Hot oil tanks, unless located under a very high or fire-resistive ceiling, should be provided with a non-combustible hood and tube passing to outside the building to serve as a vent in case of fire. In some cases a fan may be necessary, but its use should be avoided where adequate ventilation otherwise can be obtained. Care should be taken in providing such a hood to minimize interference with the protection of the building by hose streams and the hood should be slightly larger than the tank to shed from the oil tank water so applied. All such tubes should be treated as flues and kept well away from flammable roofs or other combustibles.

Tanks shall not be located on or near combustible floors. Combustible stock and other combustible materials should be kept well away from them. Door sills into other rooms, if near, should be raised to prevent the flow of oil or water carrying burning oil through them, except that this provision may be waived when floors are provided with otherwise adequate drainage. Tanks shall be located a safe distance from furnaces or other such hazards likely to flash fire to the tank or its vapors.

Overflow pipe shall be provided to prevent the oil rising to a point nearer than 4 in. of the top of the tank and a drain should be provided at the bottom of the tank. These may be combined with the circulating system if desired or arranged independently, to drain the oil to a safe place.

The inspection department having jurisdiction shall be consulted as to whether the valve in the drain shall be operated automatically with approved heat release devices or manually, and if the latter, whether the valve should be arranged for operation from a distance.

Inspection departments having jurisdiction shall be consulted as to whether standard automatic means for extinguishment should be provided and whether automatic should be combined with manually operated devices. If automatic foam extinguishing systems are used, they should be standard.

An approved 40-gal. foam type extinguisher on wheels and other standard first aid apparatus should be provided.

### Natural Sodium Compounds and Borates in 1921

The production of natural sodium compounds in the United States in 1921 amounted to 25,000 short tons valued at \$894,000. This was a decrease of about 41 per cent in both quantity and value from the 1920 figures. The material was marketed as the carbonate, bicarbonate, sulphate and borate and as trona, a double salt of carbonate and bicarbonate.

The production of boron ores in 1921 was approximately 50,000 short tons valued at \$1,320,000 and marketed as borax and colemanite. This represents a decrease of over 58 per cent from the quantity shipped in 1920.





## Cleveland Meeting, National Lime Association

**Varied Technical Program Covers All Phases of Association Activities—Experience With Mount Kilns at Rockland, Me.—Lime Burning in Rotary Kilns—Symposium on Lime for Chemical Industries—Effect of Lime in Concrete—Work of the Chemical Department**

**I**N OPENING the fourth annual convention of the National Lime Association, at the Hotel Statler, Cleveland, June 13, President Charles Warner said that from one point of view it was fortunate that the industry did not comprise thousands of producers, for it enabled the members to get together in a way which would not be possible in a large organization. This spirit of good fellowship was manifest throughout the various phases of the convention activities.

In addition to the technical program, some features of which are noted below, there were inspiring luncheon addresses by Hon. Newton D. Baker, former Secretary of War, H. Elmo Martin and George A. Coulton, vice-president of the Union Trust Co., Cleveland.

### EXPERIENCE WITH MOUNT KILNS AT ROCKLAND, ME.

Successful operation for nearly a year has served to dispel the skepticism regarding the Rockland & Rockport Lime Corporation's venture at Rockland, Me. The battery of six continuous-discharge vertical Mount kilns has proved to be nearly automatic, only 10 men being required for 24-hr. operation—3 foremen, 3 gas producer tenders, 2 skip operators and 2 handy men (day only). It has been found possible to produce 125 to 130 tons per day of 24 hr. with 5 kilns.

As would naturally be expected, experience developed the desirability of making certain changes in the original plans. Some of the more important of these were discussed and illustrated by N. L. Rockwood, editor of *Rock Products*.

In order to study the action of different sizes of stone in the kilns, the shaking grizzly has been replaced by a revolving screen giving four sizes. It was found necessary to design special bin gates to withstand the rough service in feeding the kiln-charging skips. The two suction fans on top of the kilns did not maintain sufficient draft and they were temporarily speeded up to twice their normal capacity but are now being replaced by larger fans. With these it will be possible to control the burning by regulating a draft damper.

An average of 6 tons of lime is produced per ton of coal, including that used under the boilers. Lime is discharged practically cold while the flue gas tempera-

ture is only 250 deg. C. Water used for cooling the gas valves goes to the boilers.

In effect this plant is a huge laboratory for the lime industry, where the effects of various factors can be determined under operating conditions.

### LIME BURNING IN ROTARY KILNS

Problems encountered in attempting to burn lime in rotary kilns were considered in a very comprehensive manner by Irving Warner, plants manager, Charles Warner Co. Because of different conditions, it is not possible to follow cement mill practice too closely and yet it is difficult to determine the proper modifications because of the limited number of rotary kilns in the lime industry. The capacity of this type of kiln is so great that few lime manufacturers have more than one, with the result that experimental work is very limited. With only one kiln, heat recovery systems are hardly profitable and the same may be said of separate powdered coal systems, such as are found in cement mills. There are on the market self-contained powdered coal units which could be used with a single kiln and it is planned to install one of these in connection with the 8 x 150 ft. rotary at the Cedar Hollow plant, which is now using excess producer gas from the Mount kiln unit.

Small stone (from  $\frac{1}{4}$  to  $\frac{1}{2}$  in.) was found to work best, although in order to avoid crushing the kiln is actually run on  $\frac{1}{2}$ - to  $1\frac{1}{4}$ -in. stone. A constant ratio should be maintained between the feed and the speed of the kiln. For controlling the latter a variable speed motor may be used. The inclination of the kiln under discussion was  $\frac{3}{4}$ -in. per ft. but  $\frac{1}{2}$ - to  $\frac{3}{4}$ -in. is better, since a greater inclination cuts down speed and agitation of the charge.

In discussion it was brought out that while silica brick work very well in Mount kilns, they cannot be used in the rotary type because of the tendency to spall, the high heat conductivity which would increase radiation losses and the high coefficient of expansion.

### Symposium on Lime for Chemical Industries

Parts of the Thursday afternoon and Friday morning sessions were devoted to very practical and instructive

discussions of the application of lime in several branches of the chemical industry.

#### PAPER PULP AND GLASS

Data on the use of lime in the preparation of cooking acid for sulphite pulp were presented by P. A. Paulson, consulting engineer, Appleton, Wis.

In liberating cellulose from wood by treatment with acids, many of the inorganic acids yield insoluble, dark-colored decomposition products. When compounds such as calcium and magnesium bisulphites are used, this difficulty is overcome, as the decomposition products remain in solution. Two systems are employed for making the cooking acid—the milk-of-lime and the tower. In the former, high-magnesia lime is slaked, made up to a 1 deg. Bé. milk of lime and saturated with sulphur dioxide. In the latter, high-calcium limestone is placed in a tower through which water and sulphur dioxide pass counter-currently, the cooking acid being removed at the base of the tower. The two bisulphites differ somewhat in their action. Calcium bisulphite is unstable when heated, forming a precipitate of calcium sulphite, and tends to give a harsh transparent pulp. The magnesium salt is more stable so that the liberation of  $\text{SO}_2$  during the cooking is more gradual. The resulting pulp is softer, whiter and purer. For these reasons many mills prefer to use a cooking acid containing both bisulphites.

R. P. Shiveley, of the Monongah Glass Co., outlined briefly the uses of lime in the glass industry. Constant physical properties are required in glass for use on machines, since the machines cannot allow for variations as did the hand operators. Also producer gas is less uniform than the natural gas formerly used, so that more attention must be paid to the uniformity of raw materials. Limestone, quicklime and hydrated lime are used, the former being cheaper but more difficult to melt than either quicklime or hydrate. As a rule, high magnesia content is desirable for pressed glass while blown glass requires high-calcium lime.

Causticizing problems were taken up by G. K. Spence, chief chemist, New York and Pennsylvania Paper Co., Johnsonburg, Pa. Waste of time and material is now avoided by testing each shipment for active  $\text{CaO}$  before acceptance. The lime should contain not less than 90 per cent active  $\text{CaO}$  nor more than  $1\frac{1}{2}$  per cent  $\text{MgO}$  or  $\text{SiO}_2$ . Sludge is being reburned or dried for use as agricultural lime or whiting.

#### WATER SOFTENING

A paper by S. C. Hadden, editor of *Municipal & County Engineering*, was read by G. J. Fink. It was a strong plea for the centralized softening of public water supplies. The lime-soda ash process is about the only one available for whole municipalities. After-deposits can be eliminated if the filtration plant is properly designed. From data on 338 municipalities in Illinois, a conservative estimate of the amount of lime which could be used throughout the country is 1,000,000 tons per year, which contrasted with the present 30,000 tons indicates a market only 3 per cent developed.

#### TEXTILE INDUSTRY

Opportunities for increased use of lime in the textile industry were indicated by Prof. Elton R. Darling, of James Millikin University. In boiling-out in closed kilns, lime has many advantages over caustic soda. It

gives an even boil, leaves the goods with a proper bottom for sizing and completely removes the waxy materials by its combined saponifying and emulsifying action. If lime could be substituted for caustic soda wherever it would be advantageous to do so, it is estimated that the increased demand for lime would amount to about 200,000 tons a year.

#### EFFECT OF LIME IN CONCRETE

W. E. Emley, of the Bureau of Standards, summarized some very important findings on the effect of adding lime to concrete. Additions of 5, 10 and 15 per cent of hydrated lime were made to the following concretes: 1:1 $\frac{1}{2}$ :3; 1:2:4; 1:2 $\frac{1}{2}$ :5; 1:3:6. Different amounts of water were added and compressive strength and flow plotted against per cent water by weight. Results may be summarized as follows: If water is added to a given concrete, but no lime, the flow increases while the strength decreases; if lime is added but no water, flow decreases while strength increases. The effect depends also upon the properties of the original concrete and the net effect of adding both water and lime may be plus, minus or zero.

#### INTERESTING PROPERTIES OF LIME

Prof. F. C. Mathers, of the University of Indiana, made some interesting observations on the effect of addition agents on the slaking time and on the rate of settling of hydrate. Thus, 5 per cent  $\text{HCl}$  decreased the slaking time from 12 min. to  $\frac{1}{2}$  min., while a small amount of sugar in the water used for slaking increased the time to 2 hrs. Similarly, sugar decreases the rate of settling of hydrate while  $\text{CaCl}_2$  hastens settling.

When hydrated lime is reburned at 840 deg. F., a very active form of lime results. The addition agents noted above are without effect upon it. It would seem to be very effective for the preparation of absolute alcohol as it combines almost instantly with the water in 95 per cent alcohol.

#### VALUE OF RESEARCH TO INDUSTRIAL ASSOCIATIONS

In discussing the value of research to industrial associations, E. R. Weidlein, director of Mellon Institute, emphasized the fact that America now leads the world in the application of science to industry and that this is due in no small measure to the tendency away from the secrecy which formerly surrounded industrial developments.

A centralized research laboratory maintained by an association is particularly valuable to the small manufacturer and it also prevents much unnecessary repetition. It should function to create improvements in technical processes, to disseminate the knowledge thus obtained and to maintain systematic co-operation through contact with other branches of industry. A fact which should not be lost sight of is that both labor and capital benefit from improvements in technology, for if a product is made cheaper the demand increases, while if it is made better, new markets are attracted.

#### OFFICERS FOR NEXT YEAR

The following officers were elected to serve for the year 1922 to 1923: President, Charles Warner, of Charles Warner Co., Wilmington, Del. and Philadelphia, Pa.; vice-president, George Nicholson; treasurer, Milton McDermott; secretary and general manager, N. G. Phillips. The following division managers were appointed: Agricultural division, J. A. Slipper; construction division, W. A. Freret; chemical division, M. A. Holmes.



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## Technical News of the Week

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Current Events in the Chemical, Metallurgical and Allied Industrial Fields—Legislative Developments—Activities of Government Bureaus, Technical Societies and Trade Associations

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### American Potash Now Said to Meet Government Purity Standard

American potash is now of a degree of purity well within the standard set by the United States Department of Agriculture, according to a statement by the Bureau of Soils. Under the present method of producing potash at Searles Lake, Cal., there no longer exists the former danger to crops from the presence of borax in the fertilizer.

The department has followed closely the course of American potash production, not only with a view to assisting in establishing commercial sources of potash but also to maintaining a quality that would be suitable for use as fertilizer without fear of injury to crops. During the summer of 1919, the attention of the department was directed to injury to crops by the use of fertilizers. The injury was widespread and serious especially to the tobacco and cotton crops of the eastern districts of North and South Carolina and to the Maine potato crop.

The discovery of the ill effects of borax led the department to issue an order limiting the amount of borax that could be present in a mixed fertilizer, unless specifically labeled, to an amount that would be equivalent to not more than 2 lb. per acre in the applications used by the growers. The department also forbade the sale to farmers, as straight goods, of potash salts containing more than  $\frac{1}{2}$  of 1 per cent of anhydrous borax.

As originally obtained by the producers, the potash salts which were the cause of crop injury ranged in content of borax from 4 to 14 per cent. Immediate steps were taken to improve the methods of recovery and to eliminate the borax as far as practicable. The results of the refinement of methods show that it is practicable to produce potash salts from the Searles Lake brine with a borax content well within the limit of safety set by the department. Analyses show that in the salts produced during the period 1920 to 1922 the borax content ranged from 0.27 to 0.50 per cent, which compares favorably with the content of borax in sodium nitrate.

### Bounty for Domestic Potash Agreeable to Producers

Opposition from the farmers to the proposed duties on potash has been an important factor in inducing the Finance Committee of the Senate to revise further the tariff bill by placing potash on the free list and bringing in a proposal for a bounty which would offer a financial encouragement to the American industry equivalent to the protection carried in the bill passed by the House.

Chairman McCumber, of the Finance Committee, pointed out that if the bounty were made effective today, nothing would be paid out, as he says there is no potash being produced domestically. Even during the height of the war when potash rose to \$450 per ton, the maximum production was 54,000 tons, he pointed out. If the domestic production were to reach 50,000 tons a year during the 5-year period over which the bounty would apply, bounty payments would not exceed \$2,500,000 for the first year; \$2,500,000 for the second year; \$2,000,000 for the third year; \$1,500,000 for the fourth year and \$1,000,000 for the fifth year.

The representatives in Washington of the domestic industry seem to be entirely willing to accept the bounty proposal, but it is predicted in some quarters that the attitude of the potash producers will change. This is based largely on the experience with the sugar bounty. A direct payment of public money to an industry seems to arouse much greater resentment than does the payment of even a larger amount of tax at the custom house.

### Delay of Dye Embargo Vote Pleases Opponents

Consideration by the Senate of the naval appropriation bill and debate on the policy with regard to soldiers' bonus had the effect of displacing the tariff bill during the greater portion of the past week and as a consequence the vote on the dye embargo was deferred.

There is increased reason to believe that the embargo proposal has the support of sufficient votes to secure its adoption. This practically has been admitted by its opponents and their policy is to delay its consideration as long as possible in the hope that something may happen to make the plan less popular.

### Latest Muscle Shoals Minority Report Augments Growing Opposition to Ford Proposal

Since the introduction of bills more than two weeks ago, emanating from the Committee on Military Affairs of the House of Representatives, proposing the acceptance of Henry Ford's offer for the government Muscle Shoals properties in one case and the acceptance of the offer minus the Gorgas steam plant in the other, the matter of a Muscle Shoals policy has been uppermost in the minds of the majority leaders in each House. No formal announcement has been made but it is believed that they oppose any vote on the proposition at this time.

During the two weeks that members of Congress have had in their hands the reports of three groups within the Military Affairs Committee, the opposition to the acceptance of the Ford offer has grown steadily. This trend was augmented greatly when Representative Kearns of Ohio brought out another minority report signed by seven of his colleagues on the Military Affairs Committee. This report assails the Ford offer in vigorous fashion. "If we were believers in fables, or had faith to believe in the pranks of fairies," says this report, "then we might think Mr. Ford is the reincarnation of Alladin plus his lamp."

### WEEKS DISPLEASED WITH FERTILIZER CLAUSE

Emphasis is laid on the fertilizer feature of the Ford offer in this report. It points out the fact that Mr. Ford has always refused to allow himself or his company to be bound without qualification to the continuous manufacture of fertilizer at Muscle Shoals, provided this plant is turned over to him. It recalls the testimony of Secretary Weeks before the committee in which the War Secretary stated that Mr. Ford had flatly refused to guarantee to continue to manufacture fertilizer during the life of the contract. Moreover, the manufacturer let it be distinctly understood that he would stop the manufacture of fertilizer if he could not make it profitably. The report points out that the precise meaning of "profitably" is unknown. Because of this frank admission and many kindred statements, continues the report, Secretary Weeks was entirely displeased with the language in the so-called fertilizer clause in the Ford offer. Later testimony in support of the fertilizer clause does not change his attitude.

### REPORT POINTS OUT JOKERS IN FERTILIZER PROVISIONS

The report acknowledges that a great part of the farm lands of the United States is in great need of plant food and that Congress would be justified in departing from its old policies and traveling a long way to assist in getting fertilizers cheaply for the farmers. It is felt, however, that the Ford offer is a hollow promise made to enlist the support of the farmers and not absolutely binding on any fact contained in the contract or existing outside of the contract. These statements are made and sent broadcast throughout

the country without regard to truth. The bold declaration is made that Mr. Ford will manufacture fertilizer at the Muscle Shoals plant and bring down the price one-half. Nothing is ever said that the principal business of Mr. Ford—should he get this gigantic plant—would be the manufacturing of other articles which he would be allowed to sell at any price that he might see fit. The only thing that is kept before the public is that he is to make fertilizer and sell it cheaply to the farmer, only charging for himself a profit of 8 per cent on the production. No one has ever suggested how he could make fertilizers and sell them cheaply or what means he would employ. The bold claim is made and Congress and the country must take the statement as absolute truth or be forever condemned by this crowd of wicked propagandists.

While the minority headed by Mr. Kearns points out the comparative advantages which would come from the distribution of this power by the Alabama Power Co., subject as it is to the control of public utilities commissions, the acceptance of that company's offer is not recommended. On the contrary, it is suggested that the government should complete the dams and that the Secretary of War should call for new bids with the understanding that neither of the nitrate plants is to be sold. If these were leased along with the dam, it is pointed out that the government could exercise control and regulation.

#### AGRICULTURAL INTERESTS BACK FORD

The American Farm Bureau Federation in a formal statement reiterates its statement that the acceptance of the Ford offer means that there will be reasonable expectation that fertilizers will be produced at Muscle Shoals and delivered to the farmer for about one-half what he would pay for them otherwise.

The Farm Bureau Federation, which is the largest of the national organizations of farmers, also denounces in no uncertain terms the minority report submitted by Representative Kearns. The statement says in part:

"We resent the statement that the Ford offer contemplates a fraud. It seems to be the familiar cry of 'stop thief!' while the selfish interests get away with the goods.

"We have studied this Muscle Shoals project and have investigated it carefully from every angle. The farmer well knows what can be done at Muscle Shoals under the Ford plan and does not need the protection of self-appointed guardians from the big fertilizer distributing centers and those who represent the selfish interest groups in the upper eastern section of the country, a section which, although it raises but one week's supply of cereal and meat for itself continually has undertaken to block the farmer in his efforts to secure cheaper food production and better living conditions.

"In the matter of fertilizer production at Muscle Shoals, the farmers need no such experts to advise them as Hugh L. Cooper, who represents the du Pont interests, the Aluminum Company of America and the General Electric Company."

#### WOULD MAKE APPROPRIATION CONTINGENT ON ACCEPTANCE OF OFFER

When the \$7,500,000 appropriation comes to a vote in the House, an effort will be made to attach a condition that it will not become available until the Ford offer either has been accepted or rejected. The idea is that if the Ford offer is accepted, then the appropriation should be applied under the terms of that proposition. If the Ford plan should be rejected an effort will be made to condition the appropriation so that it may be applied under the plan for government operation.

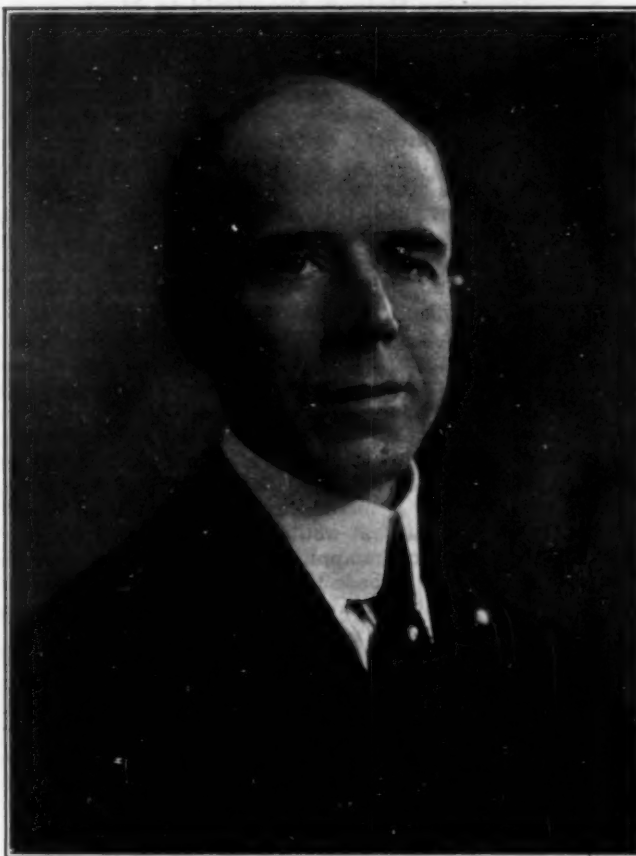
#### Chemical Warfare Service Granted Increase in Appropriation

An appropriation of \$600,000 for the Chemical Warfare Service for the next fiscal year was agreed upon by the conferees on the War Department appropriation bill on June 22. It will be remembered that the bill as passed by the House carried \$500,000 for the Chemical Warfare Service. This amount was raised by the Senate to \$750,000. The compromise figure of \$600,000 was decided upon after an extended discussion.

#### Plans Maturing for Pittsburgh Meeting of American Chemical Society

Preliminary plans for the Pittsburgh meeting of the American Chemical Society have been announced by the local section. It is expected that the convention will bring about 2,000 visitors to the steel city September 4 to 9.

James O. Handy, director of the Pittsburgh Testing Laboratory, is chairman of the Pittsburgh Section of the Society and is actively engaged in arranging the details



JAMES O. HANDY

of the meetings and entertainment features that are scheduled as features of the convention. The Council meeting will be held Monday, Sept. 4, followed by a dinner at the Duquesne Club and a theater party. The first general meeting will be at Carnegie Music Hall on Tuesday morning. Scientific papers of general interest to chemists and the public and several addresses by officials will be given. The general meeting will be continued in the afternoon and followed by a smoker at Syria Mosque in the evening.

Divisional and sectional meetings will begin on Wednesday and will continue through Thursday. A large number of papers have already been scheduled for the technical sessions. The public meeting, which is to be held in Carnegie Music Hall, will be featured by the address of Edgar F. Smith, president of the Society. Friday will be devoted to excursions to industrial plants in the vicinity of Pittsburgh. Plans are also under way for social features and entertainment of visiting ladies.

A novel event which is scheduled in connection with the convention is the installation of a chapter of Iota Sigma Pi composed of about 50 women chemists. This group, each member of which is following chemistry as a profession, has applied for a charter and expects to be installed at that time.

#### Water Pollution Conference to Be Called

An international conference of maritime nations to consider means for prevention of the pollution of navigable waters by oil burning steamers is provided in the bill recently passed by the Senate. The bill, which is now before the President for his signature, authorizes the Chief Executive to call the conference.



### Manufacturing Chemists' Association Fiftieth Annual Meeting

The Manufacturing Chemists' Association of the United States celebrated its golden anniversary at its recent annual meeting held at the Whitehall Club in New York City on June 16. The salient features of the business to be conducted were the election of officers and the reading of Chairman Henry Howard's comprehensive report of the Executive Committee. This report outlined the action taken by the association on important legislative matters, such as the pending tariff and the proposed American valuation feature, the revival of the German patent treaty, the soldiers' bonus, and the bill to prohibit commercial bribery. The co-operation with such agencies as the Chemical Foundation, the Industrial Conference Board and National Foreign Trade Council was reviewed in the committee's report.

The report also contained the first public announcement of the association's negotiations with Secretary Hoover in connection with the publication of production statistics. A committee composed of President Charles L. Reese, Henry Howard and W. H. Nicholls Jr. had gone into the matter very thoroughly and concluded that the compilation of the information sought would entail considerable work and expense to the manufacturers and would more than negative any possible good coming from their publication. This was explained to Mr. Hoover and the project was abandoned.

The officers elected for the coming year are referred to under "Personal."

### Chemical Exposition Back to Grand Central Palace This Year

Owing to the fact that the project to turn the Grand Central Palace, New York, into an office building has been abandoned, the Eighth National Exposition of Chemical Industries will again go back to its original home at the Palace when it is held this year during the week of Sept. 11. Last September the proposed plan of remodeling the Palace forced the Chemical Exposition to seek other quarters. The only other building, large enough and suitable for the purpose, which was available in New York was the Eighth Coast Artillery Armory.

The central location of this year's exposition, combined with the fact that the chemical industry is once again looking upward after a slump of eighteen months, is the basis for laying plans to accommodate a record attendance. Conservative estimates place the number of exhibitors who are expected to display their goods at the Exposition this year at a minimum of 450.

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## Personal

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WILLIAM P. ALLEN, assistant general manager of the Cellulose Products Department of E. I. du Pont de Nemours & Co., Wilmington, Del., has been appointed general manager to succeed R. R. M. Carpenter, vice-president of the company, who has been acting in this capacity during the reorganization period since last October and who will retire from the office on June 30.

ALFRED COTTON BEDFORD, chairman of the board of directors of the Standard Oil Company of New Jersey, had conferred upon him the honorary degree of Doctor of Laws at the commencement of the University of Pittsburgh on June 14. This honor was bestowed upon Mr. Bedford in recognition of his activities in the development of the American petroleum industry and for his foresight in the encouragement of the application of scientific research.

Prof. WILLIAM L. DEBAUFRE, chairman of the department of mechanical engineering of the University of Nebraska, is spending the summer in Washington as a member of the technical staff of the Bureau of Mines cryogenic laboratory.

C. R. DELONG, chief chemist of the U. S. Tariff Commission, has been selected to head the new chemical division of

the Bureau of Foreign and Domestic Commerce, Department of Commerce. It is understood that the division will commence its work on Aug. 1.

Dr. ELBERT C. LATHROP of Wilmington, Del., will shortly sever his connection with the du Pont company, where he has been manager of the standards division of the chemical department, and will join the organization of Samuel P. Sadtler & Son, Inc., as vice-president and treasurer. The arrangement will be effective on July 1.

PAUL W. LITCHFIELD, vice-president and factory manager of the Goodyear Tire & Rubber Co., Akron, Ohio, has sailed for Europe, to be absent on business for about 7 weeks. He will make a survey of current conditions in the industry in England, Scotland, Belgium, France and Germany.

TILLMAN D. LYNCH, an engineer with the Westinghouse Electric & Manufacturing Co., has received the nomination for the presidency of the American Society for Steel Treating.

CHARLES L. REESE, of the du Pont Company, was elected president of the Manufacturing Chemists' Association, New York, at the annual meeting held at the Whitehall Club, June 16. C. WILBUR MILLER, of the Davison Chemical Co., was elected vice-president; M. C. WHITAKER, of the U. S. Industrial Alcohol Co., second vice-president; S. W. WILDER, of the Merrimac Chemical Co., treasurer, and JOHN I. TIERNEY, of Washington, D. C., secretary.

Dr. J. W. TURRENTINE, formerly director of the experimental kelp-potash plant of the U. S. Department of Agriculture at Summerland, Calif., has obtained a furlough from the department for 6 months to act as consulting chemist for the U. S. Kelp Products Corporation, the newly organized concern which has purchased the government's plant and is now proceeding with the manufacture of kelp products.

EDWARD R. WEIDLEIN, director of the Mellon Institute of Industrial Research of the University of Pittsburgh, addressed the fourth annual convention of the National Lime Association, June 16, on "The Value of Research to Industrial Associations." The convention was held in Cleveland, Ohio.

W. WOODWARD WILLIAMS, formerly of Pittsburgh, Pa., has been elected vice-president of the Titan Iron & Steel Co., Inc., Newark, N. J.

E. G. ZIES of the Geophysical Laboratory, who expected to spend this summer in Hawaii investigating the gases from the volcanic eruptions there, has returned to Washington. Plans for the trip were materially changed because the expected lava flows from Kilauea did not materialize and the lava is now receding rapidly in the crater.

Recent appointment to industrial fellowships in the Mellon Institute of Industrial Research of the University of Pittsburgh include the following: E. R. Clark (B. A. Yale); H. E. Dietrich (A. B., Kansas); Marc Darrin (B. S. and M. S., Washington); O. B. J. Fraser (B. S., Queen's University); A. W. Harvey (B. S., Syracuse; M. S. and Ph. D., Pittsburgh); C. R. Texter (B. S., Pennsylvania State); and B. B. Wescott (B. S. and M. S., Pittsburgh).

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## Obituary

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WILLIAM G. GRIEB, of Scarsdale, N. Y., one of the founders of the Ajax Rubber Co., Trenton, N. J., and former president of the company, died suddenly at his home, June 13, aged 64 years. He was actively connected with the company from its inception in 1908 until 1918, when he retired to give his services to the government during the war period. He is survived by his wife and six children.

JOHN CRAIG HAVEMEYER, of Yonkers, N. Y., retired sugar refiner and well known throughout this industry, died at his residence, June 8, in his ninetieth year. He began in the sugar-refining business at the age of 21, and later was associated with his brother in the firm of Havemeyer & Co., with refinery at Greenpoint, L. I. He retired from active business in 1880 on account of poor health.

## Market Conditions

### IN CHEMICAL, METALLURGICAL AND ALLIED INDUSTRIES

A Survey of the Economic and Commercial Factors That Influence Trade in Chemicals and Related Commodities—Prevailing Prices and Market Letters From Principal Industrial Centers

#### The Coal and Coke Situation

As the coal strike enters its thirteenth week, a few of the consuming industries are beginning to show a little more interest in the trend of production at the mines and in the marketing situation as it affects existing stocks. With this in mind a study has been made of the current production statistics being issued by the U. S. Geological Survey and of the market analyses appearing in the weekly issues of *Coal Age*. Barring the recent strife and uprising in the Illinois mines, it would appear that at the present time most interest is concentrated in the constantly recurring rumors of an early settlement in the bituminous coal fields. Most of these rumors are apparently founded on the belief that important interstate negotiations are likely to occur within the near future. So far, however, these have brought forth only vigorous denials from union officials in the Middle Western fields.

Some little anxiety is being shown in the Northwest on account of the fact that practically no coal has been moved to the upper lake docks and it may yet become necessary to meet an unprecedented lake demand, calling for as much as a million tons a week for 15 to 20 weeks. Aside from this situation, however, *Coal Age* is of the opinion that "the condition of the country with respect to bituminous coal on July 1 will not be far from what may be described as normal with respect not only to production and distribution, but also as to stocks."

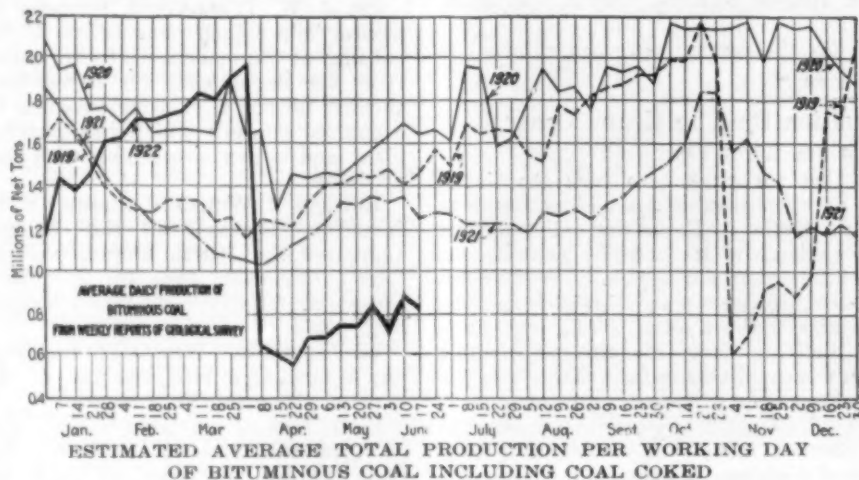
The most potent influence as regards the market is the set of "reasonable" prices established by Secretary Hoover. These are generally regarded as a bulwark against prohibitive prices, but it is interesting to note that in most districts the coal market has been so inactive that prevailing prices are substantially less than those which Mr. Hoover holds to be adequate and satisfactory. The *Coal Age* index of spot bituminous prices stood at 274 on June 19, as compared with 284 on June 12, 255 on June 5 and slightly over 300 during

the last week of May. The June 19 figure represents an average mine price of \$3.31 per ton, a drop of 13c. from that of the preceding week.

The Geological Survey's estimates of the average total production of bituminous coal is shown in the accompanying chart from Jan. 1 to June 17, 1922. During the eleventh week of the strike (June 12-17) production was expected to show a decrease from the 5,078,000 net tons produced during the tenth week. Present production is compared with that of a year ago in Table I.

The anthracite situation remains unchanged; production continues to be practically nil. In the tenth week of the strike (June 3-10) the output was limited to 253 cars, all of which, so far as reported to the Geological Survey, was steam coal

dredged from the rivers. In the corresponding week a year ago 1,963,000 tons was produced. Production of beehive coke in the week ended June 10 shows no improvement over the two weeks before the Memorial Day holiday. From records of cars of coke loaded at the ovens for shipment, the Geological Survey estimates the total output at 98,000 tons. In the week



of May 27 production had been reported to be 97,000 tons.

#### BYPRODUCT COKE PRODUCTION

Production of byproduct coke continues to increase despite coal strike conditions, thus reflecting the improved business conditions in the metallurgical industry. In May over 2,500,000 tons of byproduct coke was produced.

TABLE I—ESTIMATED UNITED STATES PRODUCTION OF BITUMINOUS COAL (IN NET TONS)

	1922		1921	
	Week	Calendar Year to Date	Week	Calendar Year to Date
May 27.....	4,889,000	162,498,000	8,166,000	158,706,000
Daily average.....	815,000	1,305,000	1,361,000	1,275,000
June 3.....	4,616,000	167,114,000	6,835,000	165,541,000
Daily average.....	769,000	1,280,000	1,330,000	1,277,000
June 10.....	5,078,000	172,192,000	8,010,000	173,551,000
Daily average.....	846,000	1,261,000	1,335,000	1,280,000

Thus the total coke output in May was a trifle under 3,000,000 tons. In this connection it is particularly interesting to note that the byproduct coke output of May is practically equal to the average monthly output in 1920, the year of maximum production.

In commenting on byproduct coke activities during recent months, the Survey makes the following statement:

This increasing activity in the coke industry means an increased demand for coal. In the month of May approximately 4,326,000 tons of raw coal was consumed in coke ovens. In comparison with the monthly average for 1921, this is an increase of 38 per cent. But it is still 32 per cent short of the 1920 average.

#### CHEMICAL & METALLURGICAL ENGINEERING'S WEIGHTED INDEX OF CHEMICAL PRICES

Base = 100 for the year July 1, 1913, to June 30, 1914

This week .....	156.97
Last week .....	156.89
June, 1917 .....	222
June, 1920 .....	274
April, 1918 (high)....	286
June, 1918 .....	272
June, 1921 .....	147
April, 1921 (low)....	140

The minor price changes in the chemical market during the past week have had but very little effect on the index number. Slightly higher prices were noted for ammonium sulphate, barium chloride, copper sulphate and crude potassium carbonate. Refined glycerine was the only one of the index commodities for which a lower price was being quoted.



### Mexican Petroleum's Spectacular Rise

During the week ended June 22 a series of spectacular advances in the stock of the Mexican Petroleum Co. brought its quotation up to 186 as compared with 133 on June 15. This phenomenal jump of 53 points in one week is generally attributed to a professional attempt to crowd out short holdings.

Officials of the New York Stock Exchange on June 23 ordered an investigation of the trading in this stock, requiring each member of the Exchange to render an account of his position in respect to this corporation's stock. The investigation failed to show evidence of any concerted attempt to corner the market, but it did result in a reaction which caused the stock to fall off about 10 points.

It is rather interesting to review the developments which might naturally have been expected to favor this stock. A week ago announcement was made of settlement with Huerta of the Mexican financial problem. This was followed by a tentative agreement over future development work in Mexico and finally by the corporation's annual report, which was made public June 22. This statement showed 1921 earnings of \$12,540,684, or \$26.82 per share on common stock, the best in the corporation's history.

### The Trend of Prices for Laboratory Apparatus

A most interesting study of price tendencies, particularly as related to laboratory apparatus and supplies, has been prepared by S. L. Redman, of the Central Scientific Co., and is published in the June number of *The Chemical Bulletin*. By taking as concrete illustrations eight staple items of laboratory supplies such as a No. 0 evaporating dish, a 250-c.c. Griffin beaker, a 400-c.c. Florence flask, etc., the author was able to show that the average retail prices for these items in 1919 reached a peak of 50 per cent above the pre-war year of 1913 and that the present level is about 38 per cent above the pre-war. This is to be compared with Dun's index of prices for all commodities, which had a 1919 peak 95 per cent above the 1913 level and is at present about 33 per cent above pre-war.

The prices for these items in 1913, 1919 and May, 1922, have been compared with the prices for foreign-made supplies in the following table:

Item	1913	1919	May, 1922	
			American Made	German Made
Evaporating dish, No. 0	\$0.19	\$0.24	\$0.24	\$0.35
Griffin beaker, 250 c.c.	.22	.25	.25	.25
Florence flask, 400 c.c.	.24	.27	.27	.32
Cylindrical graduate, 100 c.c.	.50	.63	.60	.69
Thermometer, 110° C.	.80	1.20	1.10	1.10
Bunsen funnel, 3 in.	.18	.43	.35	.38
Soxhlet extraction apparatus, 100 c.c.	2.70	3.85	3.80	4.00
Bunsen burner	.22	.45	.35	2.15

In order to make fair comparisons between the prices of foreign-made and domestic-made apparatus corresponding grades were selected from prominent American and foreign brands. Thus for this purpose, the following brands were assumed to be of equivalent grade: Royal Berlin and Coors porcelain dishes, Jena and Pyrex beakers and flasks, Siebert & Kuhn and Taylor thermometers, and Greiner & Friedrichs and Kimble funnels.

In outlining the present situation, as well as the probable future trend of prices, Mr. Redman summarized his remarks as follows:

"There has been a continued downward trend in the price of laboratory supplies during the past 18 months, except in those staple lines of glassware and porcelain the prices of which remained stationary during the war and post-war period of rising costs. Prices will probably continue to recede gradually throughout a period of years until the pre-war level is reached. Special instruments, whose cost of development was very high, were introduced at rather high prices and, as the process of manufacture has been perfected, generous price reductions have been made. No immediate relief is to be expected from the importation of German goods, since the difficulties experienced by German manufacturers with raw materials purchased with a depreciated currency, with restricted fuel supplies and labor troubles combine to make prices higher than those of the corresponding grade of American-made materials."

### The New York Market

NEW YORK, June 26, 1922.

The chemical market during the past week showed signs of irregularity, with the demand in most instances for specialties. One of the outstanding features in the week's trading was the firmer tone displayed in prussiates. An improved demand was also noted for sulphate of ammonia from the Far East and for caustic soda from several foreign countries. Prussiate of soda has shown a strong tendency to recover from its recent slump and prices gained 1c. per lb. during the latter part of the week. Copper sulphate continued along the same steady lines, with spot stocks exceedingly light and prices firmly maintained. Yellow and red prussiate of potash are quoted higher because of the pronounced scarcity. Tartaric and citric acids are moving as usual at this season and prices are quoted fractionally higher on both items.

#### GENERAL AND SPECIAL CHEMICALS

**Acetic Acid**—Commercial 28 per cent is being quoted at 2½@2¼c. per lb. by producers, with the demand only moderate. Glacial is held at 8½@9c. per lb. by second hands. Competition in the higher grade is much keener for passing business.

**Ammonium Sulphate**—Export inquiry has contributed to the better demand and prices among leading dealers were held around \$3.30@\$3.40 per 100 lb., f.a.s. New York.

**Carbonate of Potash**—The 80-85 per cent calcined, on spot, is reported firmer and prices were quoted on the basis of 5@5¼c. per lb. by prominent importers. Business in this product has been rather quiet during the past few weeks.

**Caustic Soda**—Quotations for 16 per cent solid, standard branch, are named around \$3.80@\$3.85 per 100 lb. f.a.s. New York. Export inquiries are showing increased proportions and leading factors are of the opinion that business will show a marked increase in volume in the very near future. Domestic resale is quoted at \$3.75 per 100 lb. Contracts remain notably unchanged.

**Chlorate of Potash**—Imported material has been offered rather freely at 6¼@6¾c. per lb. Domestic makers continue to name 8c. per lb. f.o.b. works and are holding firm at this level.

**Chloroform**—Producers have reduced prices on U.S.P. goods in quantities of 50 lb. to 25c. per lb., drums extra. Small lot containers are quoted at 28¼@32c. per lb., depending upon size.

**Citric Acid**—The general condition of this market has shown a noticeable improvement with the coming of the hot weather. Some large sales were reported at 45c. per lb. Lesser quantities were held around 45¼@46c. per lb.

**Prussiate of Potash**—Several sales of yellow prussiate were recorded at 32½c. per lb. Goods due to arrive from abroad were offered at 31@31½c. per lb. The market displayed a much firmer note and demand was quite active. The red variety was in exceedingly light supply at 90@95c. per lb.

**Prussiate of Soda**—Prices during the week have shown a net advance, and 22c. per lb. was named as the low figure. Several heavy arrivals of imported material were reported during the week, but these apparently had no effect on quotations.

**Tartaric Acid**—Crystals are quoted at 29½c. per lb. and powdered at 30c. Domestic makers continue to quote 30c. per lb.

**Zinc Sulphate**—Producers report a regular demand from the paint trade and quote carlots at 2¼c. per lb. Smaller lots are named around 3@3½c. per lb., depending upon quantity.

#### VEGETABLE OILS

**Cottonseed Oil**—Trading in the various grades was limited and prices were somewhat irregular.

**Linseed Oil**—During the early part of the week prices were rather weak and sales were reported down to 80c. per gal. The latter part, however, brought the market to a firmer position and leading crushers advanced their prices to 82c. per gal. The general inquiry was quiet, with the larger consumers content to watch for further developments. English oil displayed a firmer tone and quotations were heard around 76½c. per gal., duty paid.

## The Iron and Steel Market

PITTSBURGH, June 23, 1922.

The steel market has grown still quieter in the past week as to the total tonnage turnover, while prices in a general way have shown a stiffening tendency.

The decrease in the tonnage turnover represents a continuance of the trend that has been seen since April, which was the high month for sales, and may perhaps be attributable solely or chiefly to the near approach of the mid-summer season and the resulting dull market for steel.

It is no new experience for the steel market to appear to grow firmer as it becomes less active. The point is that when there is a heavy turnover the sales are chiefly for extended delivery, at basis prices. When forward buying decreases in volume the buying for early delivery is forced into prominence. The prompt prices contain delivery premiums, but the appearance is that of higher prices being paid on an average.

### STEEL PRICES

The American Sheet & Tin Plate Co. has opened its sheet order books for August and September at former prices, its opening on June 2 having been for July only. The prices are those that became effective early in April, there being an advance of \$3 a ton at the time, and are as follows: Blue annealed sheets, 2.40c.; black sheets, 3.15c.; galvanized sheets, 4.15c.; automobile sheets, 4.50c.

The incident is an important illustration of what has come to be recognized as the Steel Corporation's policy to hold its prices substantially at the present level, since advances occurred earlier in the year in the lines that were selling at unreasonably low levels on the basis of production cost. In the majority of lines, including sheets, so many independents have been quoting advanced prices that it would have been entirely feasible for the corporation to establish higher levels.

The finished steel market is quotable as follows: Bars, shapes and plates, 1.60@1.70c.; hoops and bands, 2.40@2.50c.; wire nails, \$2.40@\$2.50; blue annealed sheets, 2.40@2.50c.; black sheets, 3.15@3.30c.; galvanized sheets, 4.15@4.30c.; automobile sheets, 4.50@4.75c.; tin plate, \$4.75; standard steel pipe, 71 per cent basing discount.

Production of steel ingots continues at a rate of about 39,000,000 tons a year, against rates of about 35,000,000 tons on April 1 and 20,000,000 tons in December. On the whole there has been a slight trend toward an increase in the past week or two. The Carnegie Steel Co. has blown in a third furnace at the Farrell plant, giving it thirty-eight furnaces in operation against thirty-four on April 1, while its ingot production is at fully 77 per cent, against an average of not over 70 per cent in the second half of March and during April.

The strike at the union coal mines shows no visible change. In the Connellsville region the return of sympathetic strikers to work in the past 10 days has been sufficient to make a decided increase in coal production, while until recently the gains in the number of workers were scarcely more than enough to show positively that the strikes were not gaining ground. Doubtless on the whole the steel industry has drawn largely upon its stocks of coal, but it certainly exhibits no signs of being forced to reduce its operations in the near future.

### ORE, IRON AND COKE MARKETS

Open market transactions in Lake Superior iron ore have been light since the season opened a fortnight ago, the chief business being between producers and consumers having more or less joint ownership. Producers expect to sell little if any ore to Eastern furnaces for the season, because at \$5.05 f.o.b. Lake Erie dock for Mesabi non-bessemer ore the cost to Eastern furnaces is computed at \$7.07 per ton, or 13.728c. per unit, while foreign ore is quoted at 10.5c. per unit delivered and could probably be bought for less.

The pig iron market in Pittsburgh and the valleys has been very quiet in the past week. Consumers are showing greater power to stay out of the market than was expected. The iron foundries are far from busy, while the steel works that do not produce iron have not been selling their product far ahead. Buyers expect a downward readjustment in pig iron prices when coke becomes less scarce. The market

is largely nominal at former quotations, \$25 for bessemer and basic and \$24@\$25 for foundry, f.o.b. valley furnaces.

Not enough Connellsville furnace coke is moving to make a regular market. Miscellaneous consumers, other than blast furnaces, are occasionally forced to buy, paying, say, \$7.50 for standard grade, while high-sulphur coke is obtainable at \$7. Foundry coke is selling in a limited way at \$8@\$8.50.

## The St. Louis Market

ST. LOUIS, Mo., June 22, 1922.

We wish to confirm our previous reports that there is a continual steady increase in the amount of business being transacted in the industrial chemical market in this locality, and the summer lull which is usually expected at this time has not as yet appeared. We do not believe there will be any great slackening off of business during the summer period for reason that buying is still being done on a conservative basis with a quick turnover in mind, but it is true that buyers are more confident today than a year ago, and are more liberal in placing their requirements. While some few chemicals on the list, particularly the alkalis, showed a decided weakness the majority were very firm and in many instances were stiffened.

### ALKALIS

Caustic soda has shown a slight weakening since our last report and regular prices are now being shaded on large-sized orders. Carload business is increasing somewhat and it is in this class of buying where price shading is most evident. Soda ash is being offered as low as \$2.25 in barrels in lots of 5 to 10 bbl. In the main, however, the nominal price of \$2.40 in 5-bbl. lots with a 20c. differential is being maintained. Sodium bicarbonate is very unsteady and, as put by one jobber, is being sold for whatever it will bring. \$2.25 in 5-bbl. lots seems to be about the average price. Sal soda is apparently somewhat of a drug on the market. As low as \$1.65 cwt. in barrels has been reported.

### GENERAL AND SPECIAL CHEMICALS

The heavy commercial mineral acids are showing a decided improvement with prices stiffening in some directions. The demand from the fertilizer trade is very good while that from steel mills has fallen off. Carbolic is in good demand with prices firm. Spot stocks of citric acid are still very scarce and the demand this season is no greater than last, and for the present we do not believe there will be any advance in price. Phosphoric acid is moving in a good way with fairly large sales reported. White arsenic, powdered, remains the same in price at 7½c. per lb., f.o.b. St. Louis, but the market has stiffened considerably with a very good demand coming from the insecticide manufacturers. Carbon bisulphide has been moving very briskly since our last report and the demand should continue, as we are now in a season when this article will be used very extensively as an insecticide. Carbon tetrachloride is holding its own both in price and demand. Chloroform is very weak and manufacturers have found it necessary to make a further reduction of 5c. per lb. Glycerine has finally responded to prophecies and has declined to 12½c. per lb. in drums with the usual differential on cans. Contracts with protection are being offered at 15c. There has been an unexpected demand for lithium carbonate for export and some good-sized orders have been reported. Potassium cyanide stocks are very limited and the demand has been from usual channels. Sodium fluoride is not moving as freely as should be expected. Zinc spelter has stiffened a few points and is now being quoted at \$5.35@\$5.40 per 100 lb. in carload lots, f.o.b. St. Louis, while the sulphate remains the same in price as well as demand.

### VEGETABLE OILS AND NAVAL STORES

Castor oil remains firm at 12½c. in 200-gal. lots with an advance of 1c. for less quantities. Demand is good with a large volume movement. Linseed oil has shown some weakness with a decline from \$1.07 to 97c. basis raw oil. With the prospective tariff pending this price decline was hardly expected. Turpentine is holding its own very nicely having maintained its position around the dollar mark consistently for the last month.



## General Chemicals

## CURRENT WHOLESALE PRICES IN NEW YORK MARKET

	Carlots F.o.b. N.Y.	Less Carlots F.o.b. N.Y.
Acetic anhydride, lb.	\$0.09 - \$0.09	\$0.08 - \$0.40
Acetone, lb.	2.25 - 2.50	2.55 - 3.00
Acid, acetic, 20 per cent, 100 lbs.	5.00 - 5.25	5.30 - 5.50
Acetic, 56 per cent, 100 lbs.	8.50 - 9.00	50 - 9.75
Acetic, glacial, 99 1/2 per cent, carboys, 100 lbs.	11 - 11	11 - 12
Boric, crystals, lb.	11 - 11	11 - 12
Boric, powder, lb.	11 - 11	11 - 12
Citric, lb.	1.10 - 1.20	1.25 - 1.70
Hydrochloric, 52 per cent, 100 lb.	09 - 11	11 - 12
Lactic, 44 per cent tech., lb.	09 - 10	10 - 12
Lactic, 22 per cent tech., lb.	04 - 04	04 - 05
Molybdic, a.p., lb.	3.00 - 3.25	3.30 - 3.75
Muriatic, 20 deg. (see hydrochloric), lb.	06 - 06	06 - 07
Nitric, 40 deg., lb.	06 - 06	07 - 07
Nitric, 42 deg., lb.	06 - 06	07 - 07
Oxalic, crystals, lb.	14 - 14	14 - 15
Phosphoric, 50 per cent solution, lb.	08 - 08	08 - 09
Picric, lb.	22 - 24	24 - 30
Pyrogallol, resublimed, lb.	1.65 - 1.75	
Sulphuric, 60 deg., tank cars, ton	9.50 - 10.00	
Sulphuric, 60 deg., drums, ton	12.00 - 14.00	
Sulphuric, 66 deg., tank cars, ton	15.00 - 16.00	
Sulphuric, 66 deg., drums, ton	19.00 - 20.00	20.50 - 21.00
Sulphuric, 66 deg., carboys, ton		
Sulphuric, fuming, 20 per cent (oleum), ton	19.00 - 20.00	
Sulphuric, fuming, 20 per cent (oleum), drums, ton	22.00 - 22.50	23.00 - 24.00
Sulphuric, fuming, 20 per cent (oleum), carboys, ton	31.00 - 32.00	33.00 - 34.00
Tannic, U. S. P., lb.		60 - 75
Tannic (tech.), lb.	40 - 45	46 - 50
Tartaric, imported crystals, lb.		29 - 29
Tartaric acid, imported, powdered, lb.		29 - 30
Tartaric acid, domestic, lb.		30 - 30
Tung-tic, per lb. of WO., lb.		1.00 - 1.10
Alcohol, ethyl (Cologne spirit), gal.		4.75 - 4.95
Alcohol, methyl (see methanol)		
Alcohol, denatured, 188 proof No. 1, gal.		26 - 30
Alcohol, denatured, 188 proof No. 5, gal.		26 - 30
Alum, ammonia, lump, lb.	03 - 03	04 - 04
Alum, potash, lump, lb.	03 - 04	04 - 05
Alum, chrome lump, lb.	05 - 05	06 - 06
Aluminum sulphate, commercial, 100 lb.	1.50 - 1.65	1.70 - 2.25
Aluminum sulphate, iron free, lb.	02 - 02	03 - 03
Aqua ammonia, 26 deg., drums (750 lb.), lb.	06 - 07	07 - 08
Ammonia, anhydrous, cyl. (100-150 lb.), lb.	30 - 30	30 - 31
Ammonium carbonate, powder, lb.	07 - 07	07 - 08
Ammonium nitrate, lb.	06 - 06	06 - 07
Amylacetate tech., gal.		2.00 - 2.25
Arsenic, white, powdered, lb.	07 - 07	07 - 08
Arsenic, red, powdered, lb.	12 - 12	12 - 13
Barium carbonate, lb.	03 - 04	04 - 05
Barium chloride, ton	95.00 - 100.00	105.00 - 110.00
Barium dioxide (peroxide), lb.	20 - 21	21 - 22
Barium nitrate, lb.	07 - 07	07 - 08
Barium sulphate (precip.) (blanc fixe), lb.	04 - 04	04 - 04
Blanc fixe, dry, lb.	04 - 04	
Blanc fixe, pulp, ton	45.00 - 55.00	
Bleaching powder, 100 lb.	1.60 - 1.75	1.85 - 2.50
Blue vitriol (see copper sulphate), lb.		
Borax, lb.	05 - 05	06 - 06
Brimstone (see sulphur, roll), lb.		
Bromine, lb.	27 - 28	28 - 35
Calcium acetate, 100 lbs.	1.75 - 2.00	
Calcium carbide, lb.	04 - 04	05 - 05
Calcium chloride, fused, lump, ton	24.00 - 24.50	24.75 - 27.00
Calcium chloride, granulated, lb.	01 - 01	02 - 02
Calcium peroxide, lb.		1.40 - 1.50
Calcium phosphate, tribasic, lb.		15 - 16
Camphor, lb.		79 - 83
Carbon bisulphide, lb.	06 - 06	07 - 07
Carbon tetrachloride, drums, lb.	09 - 10	10 - 12
Carbonyl chloride, (phosgene), lb.		60 - 75
Caustic potash (see sodium hydroxide)		
Caustic soda (see sodium hydroxide)		
Chalk, precip., domestic, light, lb.	04 - 04	
Chalk, precip., domestic, heavy, lb.	03 - 03	
Chalk, precip., imported, light, lb.	04 - 05	
Chlorine, gas, liquid-cylinders (100 lb.), lb.	05 - 05	05 - 06
Chloroform, lb.		25 - 32
Cobalt oxide, lb.		2.00 - 2.10
Coppers, ton	20.00 - 22.00	23.00 - 30.00
Copper carbonate, green precipitate, lb.	19 - 20	20 - 21
Copper cyanide, lb.		58 - 60
Copper sulphate, crystals, 100 lb.	6.25 - 6.40	6.45 - 6.65
Cream of tartar, lb.		23 - 25
Epsom salt (see magnesium sulphate)		
Ethyl acetate com. 85%, gal.		60 - 65
Ethyl acetate, pure (acetic ether, 98% to 100%), gal.		90 - 95
Formaldehyde, 40 per cent, lb.	08 - 08	08 - 09
Fullers earth, f.o.b. mines, net ton	16.00 - 17.00	
Fullers earth-imported powdered-net ton	30.00 - 32.00	
Fusel oil, ref., gal.		2.25 - 2.65
Fusel oil, crude, gal.		1.40 - 1.50
Glauber's salt (see sodium sulphate)		
Glycerine, a.p. drums extra, lb.		14 - 14
Iodine, resublimed, lb.		4.20 - 4.25
Iron oxide, red, lb.		12 - 18
Lead acetate, lb.		09 - 11
Lead arsenate, powd., lb.	13 - 13	13 - 14
Lead nitrate, lb.		15 - 20
Litharge, lb.	07 - 08	08 - 09
Magnesium carbonate, technical, lb.	08 - 08	09 - 09
Magnesium sulphate, U. S. P., 100 lb.	2.50 - 2.60	2.65 - 2.85
Magnesium sulphate, technical, 100 lb.		1.00 - 1.80
Methanol, 95%, gal.		57 - 58
Methanol, 97%, gal.		59 - 60
Nickel salt, double, lb.		11 - 11
Nickel salt, single, lb.		10 - 10
Phosgene (see carbonyl chloride)		
Phosphorus, red, lb.		40 - 45
Phosphorus, yellow, lb.		30 - 35

	Carlots F.o.b. N.Y.	Less Carlots F.o.b. N.Y.
Potassium bichromate, lb.	09 - 10	10 - 10
Potassium bromide, granular, lb.		17 - 23
Potassium carbonate, U. S. P., lb.	12 - 12	13 - 16
Potassium carbonate, 80-85%, lb.	05 - 05	05 - 06
Potassium chlorate powdered and crystals, lb.	06 - 07	07 - 08
Potassium cyanide, lb.		45 - 50
Potassium hydroxide (caustic potash), 100 lb.	5.75 - 6.00	6.25 - 6.50
Potassium iodide, lb.		3.20 - 3.30
Potassium nitrate, lb.	06 - 06	07 - 08
Potassium permanganate, lb.	14 - 14	14 - 15
Potassium prussiate, red, lb.		90 - 95
Potassium prussiate, yellow, lb.	32 - 33	33 - 34
Rochelle salts (see sodium potas tartrate)		
Salammoniac, white, granular, lb.	06 - 07	07 - 08
Salammoniac, gray, granular, lb.	07 - 08	08 - 08
Salsoda, 100 lb.	1.20 - 1.40	1.45 - 1.60
Salt cake (bulk), ton	20.00 - 25.00	
Soda ash, light, 58 per cent flat, bags, contract, 100 lb.	1.65 - 1.70	2.00 - 2.25
Soda ash, light, 58 per cent flat, bags, resale, 100 lb.	1.80 - 1.90	1.95 - 2.40
Soda ash, dense, in bags, resale, 100 lb.	1.90 - 1.95	2.00 - 2.50
Sodium acetate, lb.	05 - 06	06 - 06
Sodium bicarbonate, 100 lb.	1.75 - 1.85	1.90 - 2.30
Sodium bichromate, lb.	07 - 07	07 - 08
Sodium bisulphate (nitre cake), ton	4.50 - 4.60	4.65 - 5.50
Sodium bisulphate powdered, U.S.P., lb.	04 - 04	04 - 05
Sodium chlorate, lb.	06 - 06	07 - 07
Sodium chloride, long ton	12.00 - 13.00	
Sodium cyanide, lb.	22 - 23	23 - 25
Sodium fluoride, lb.	10 - 10	10 - 11
Sodium hydroxide (caustic soda) solid, 76 per cent flat, drums, contract, 100 lb.	3.35 - 3.50	3.80 - 4.00
Sodium hydroxide (caustic soda) solid, 76% flat, drums, resale, 100 lb.	3.80 - 3.85	3.90 - 4.20
Sodium hydroxide (caustic soda), ground and flake, contracts, 100 lb.	3.85 - 4.00	4.30 - 4.50
Sodium hydroxide (caustic soda) ground and flake, resale, 100 lb.	4.00 - 4.15	4.40 - 4.60
Sodium hyposulphite, lb.	03 - 03	03 - 04
Sodium nitrite, lb.	08 - 08	09 - 09
Sodium peroxide, powdered, lb.	28 - 30	31 - 35
Sodium phosphate, dibasic, lb.	03 - 04	04 - 04
Sodium potassium tartrate (Rochelle salts), lb.		18 - 21
Sodium prussiate, yellow, lb.	22 - 22	22 - 23
Sodium silicate, (40 deg. in drums), 100 lb.	80 - 1.00	1.05 - 1.25
Sodium silicate, (60 deg. in drums), 100 lb.	2.25 - 2.40	2.45 - 2.75
Sodium sulphate, crystals (Glauber's salt), 100 lb.	95 - 1.05	1.15 - 1.50
Sodium sulphide, f. acid, 60-62 per cent (conc.), lb.	04 - 04	04 - 05
Sodium sulphite, crystals, lb.	03 - 03	03 - 04
Strontium nitrate, powdered, lb.	09 - 10	10 - 12
Sulphur chloride, yellow, lb.	04 - 05	05 - 06
Sulphur, crude, ton	18.00 - 20.00	
Sulphur dioxide, liquid, cylinders extra, lb.	08 - 08	09 - 10
Sulphur (sublimed), flour, 100 lb.		2.25 - 3.10
Sulphur, roll (brimstone), 100 lb.	2.00 - 2.15	2.20 - 2.70
Talc-imported, ton	30.00 - 40.00	
Talc-domestic powdered, ton	18.00 - 25.00	
Tin bichloride, lb.	09 - 09	09 - 10
Tin oxide, lb.		35 - 37
Zinc carbonate, lb.	14 - 14	14 - 15
Zinc chloride, gran., lb.	06 - 06	06 - 07
Zinc cyanide, lb.	42 - 44	45 - 47
Zinc oxide, XX, lb.	07 - 08	08 - 08
Zinc sulphate, 100 lb.	2.75 - 3.00	3.05 - 3.30

## Coal-Tar Products

NOTE—These prices are for original packages in large quantities f.o.b. N.Y.:

Alpha-naphthol, crude, lb.	\$1.00 - \$1.05
Alpha-naphthol, refined, lb.	1.10 - 1.15
Alpha-naphthylamine, lb.	30 - 31
Aniline oil, drums extra, lb.	14 - 16
Aniline salts, lb.	22 - 24
Anthracene, 80% in drums (100 lb.), lb.	75 - 1.00
Benzaldehyde U.S.P., lb.	1.25 - 1.30
Benzene, pure, water-white, in drums (100 gal.), gal.	30 - 35
Benzene, 90%, in drums (100 gal.), gal.	28 - 32
Benzidine, base, lb.	85 - 95
Benzidine sulphate, lb.	80 - 85
Benzoic acid, U.S.P., lb.	60 - 65
Benzoate of soda, U.S.P., lb.	50 - 55
Benzyl chloride, 95-97%, refined, lb.	25 - 27
Benzyl chloride, tech., lb.	20 - 23
Beta-naphthol benzoate, lb.	3.75 - 4.00
Beta-naphthol, sublimed, lb.	50 - 55
Beta-naphthol, tech., lb.	23 - 26
Beta-naphthylamine, sublimed, lb.	1.50 - 1.60
Carbasol, lb.	75 - 90
Cresol, U. S. P., in drums (100 lb.), lb.	12 - 15
Ortho-cresol, in drums (100 lb.), lb.	16 - 18
Cresylic acid, 97-99%, straw color, in drums, gal.	56 - 65
Cresylic acid, 75-97%, dark, in drums, gal.	51 - 58
Dichlorobenzene, lb.	06 - 09
Diethylaniline, lb.	65 - 70
Dimethylaniline, lb.	36 - 38
Dinitrobenzene, lb.	22 - 25
Dinitrochlorobenzene, lb.	22 - 24
Dinitronaphthalene, lb.	30 - 32
Dinitrophenol, lb.	33 - 35
Dinitrotoluene, lb.	22 - 24
Dip oil, 25%, car lots, in drums, gal.	24 - 26
Diphenylamine, lb.	59 - 65
H-acid, lb.	85 - 95
Meta-phenylenediamine, lb.	95 - 1.00
Monochlorobenzene, lb.	09 - 11
Monothylaniline, lb.	1.00 - 1.20
Naphthalene crushed, in bbls., lb.	06 - 06
Naphthalene, flake, lb.	06 - 07
Naphthalene, balls, lb.	08 - 08
Naphthionate of soda, lb.	58 - 65
Naphthionic acid, crude, lb.	65 - 70
Nitrobenzene, lb.	10 - 12
Nitro-naphthalene, lb.	30 - 35
Nitro-toluene, lb.	15 - 17
N-W acid, lb.	1.15 - 1.30
Ortho-amidophenol, lb.	2.40 - 2.50
Ortho-dichlorobenzene, lb.	2.15 - 2.20
Ortho-nitro-phenol, lb.	70 - 75

Ortho-nitro-toluene.....	lb.	\$0.13	—	\$0.13
Ortho-toluidine.....	lb.	.14	—	.18
Para-aminophenol, base.....	lb.	1.25	—	1.30
Para-aminophenol, HCl.....	lb.	1.30	—	1.35
Para-dichlorobenzene.....	lb.	.17	—	.20
Paranitroaniline.....	lb.	.72	—	.75
Para-nitrotoluene.....	lb.	.55	—	.65
Para-phenylenediamine.....	lb.	1.55	—	1.60
Para-toluidine.....	lb.	.90	—	1.00
Phthalic anhydride.....	lb.	.35	—	.38
Phenol, U. S. P., drums.....	lb.	.14	—	.15
Pyridine.....	gal.	1.75	—	2.75
Resorcinol, technical.....	lb.	1.30	—	1.35
Resorcinol, pure.....	lb.	1.75	—	1.80
R-salt.....	lb.	.60	—	.70
Salicylic acid, tech., in bbls.....	lb.	.25	—	.25
Salicylic acid, U. S. P.....	lb.	.26	—	.26
Solvent naphtha, water-white, in drums, 100 gal.....	gal.	.27	—	.32
Solvent naphtha, crude, heavy, in drums, 100 gal.....	gal.	.14	—	.18
Sulphanilic acid, crude.....	lb.	.24	—	.26
Tolidine.....	lb.	1.20	—	1.30
Toluidine, mixed.....	lb.	.50	—	.55
Toluene, in tank cars.....	gal.	.25	—	.28
Toluene, in drums.....	gal.	.30	—	.35
Xylidines, drums, 100 gal.....	lb.	.40	—	.45
Xylene, pure, in drums.....	gal.	.40	—	.45
Xylene, pure, in tank cars.....	gal.	.45	—	.....
Xylene, commercial, in drums, 100 gal.....	gal.	.35	—	.35
Xylene, commercial, in tank cars.....	gal.	.30	—	.....

### Waxes

Candelilla, wax.....	lb.	.40	—	.42
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All Other Prices Remain Unchanged

### Naval Stores

All prices are f.o.b. New York unless otherwise stated, and are based on carload lots. The oils in 50 gal. bbls., gross weight, 500 lb.

Rosin B-D, bbl.....	280 lb.	\$5.60	—	\$6.00
Rosin E-I.....	280 lb.	6.05	—	6.35
Rosin K-N.....	280 lb.	6.65	—	6.90
Rosin W. G.-W. W.....	280 lb.	7.70	—	8.35
Wood rosin, bbl.....	280 lb.	6.25	—	.....
Spirits of turpentine.....	gal.	1.25	—	1.27
Wood turpentine, steam dist.....	gal.	.85	—	.....
Wood turpentine, dest. dist.....	gal.	.70	—	.70
Pine tar pitch, bbl.....	200 lb.	.....	—	6.00
Tar, kiln burned, bbl. (500 lb.).....	bbl.	.....	—	9.50
Retort tar, bbl.....	500 lb.	.....	—	9.00
Rosin oil, first run.....	gal.	.36	—	.....
Rosin oil, second run.....	gal.	.38	—	.....
Rosin oil, third run.....	gal.	.46	—	.....
Pine oil, steam dist., sp.gr. 0.930-0.940.....	gal.	.....	—	1.00
Pine oil, pure, dest. dist.....	gal.	.....	—	.95
Pine tar oil, ref., sp.gr. 1.025-1.035.....	gal.	.....	—	.46
Pine tar oil, crude, sp.gr. 1.025-1.035 tank cars f.o.b. Jacksonville, Fla.....	gal.	.....	—	.35
Pine tar oil, double ref., sp.gr. 0.965-0.990.....	gal.	.....	—	.75
Pine tar, ref., thin, sp.gr. 1.080-1.060.....	gal.	.....	—	.25
Hardwood oil, f.o.b. Mich., sp.gr., 0.960-0.990.....	gal.	.....	—	.25
Pinewood creosote, ref.....	gal.	.....	—	.52

### Fertilizers

Ammonium sulphate, f.a.s., N.Y.....	100 lb.	3.30	—	3.40
Blood, dried, f.o.b., N. Y.....	unit	3.55	—	3.65
Bone, 3 and 50, ground, raw.....	ton	27.00	—	28.00
Fish scrap, dom., dried, f.o.b. works.....	unit	3.10	—	3.20
Nitrate of soda.....	100 lb.	2.55	—	2.60
Tankage, high grade, f.o.b. Chicago.....	unit	3.00	—	3.10
Phosphate rock, f.o.b. mines, Florida pebbles, 68-72%.....	ton	3.50	—	3.75
Tennessee, 78-80%.....	ton	7.00	—	7.50
Potassium muriate, 80%.....	ton	33.00	—	33.50
Potassium sulphate.....	unit	1.00	—	.....

### Crude Rubber

Para-Upriver fine.....	lb.	\$0.18	—	.18
Upriver coarse.....	lb.	.12	—	.12
Upriver caucho ball.....	lb.	.13	—	.14
Plantation—First latex crepe.....	lb.	.15	—	.15
Ribbed smoked sheets.....	lb.	.15	—	.15
Brown crepe, thin, clean.....	lb.	.13	—	.....
Amber crepe No. 1.....	lb.	.14	—	.....

### Oils

#### VEGETABLE

The following prices are f.o.b. New York for carload lots.

Castor oil, No. 3, in bbls.....	lb.	\$0.11	—	\$0.11
Castor oil, AA, in bbls.....	lb.	.12	—	.12
China wood oil, in bbls.....	lb.	.13	—	.14
Coconut oil, Ceylon grade, in bbls.....	lb.	.08	—	.08
Coconut oil, Cochon grade, in bbls.....	lb.	.09	—	.09
Corn oil, crude, in bbls.....	lb.	.11	—	.11
Cottonseed oil, crude (f. o. b. mill).....	lb.	\$0.10	—	\$0.10
Cottonseed oil, summer yellow.....	lb.	.11	—	.12
Cottonseed oil, winter yellow.....	lb.	.12	—	.13
Linseed oil, raw, car lots (domestic).....	gal.	.82	—	.83
Linseed oil, raw, tank cars (domestic).....	gal.	.76	—	.79
Linseed oil, boiled, in 5-bbl lots (domestic).....	gal.	.87	—	.88
Olive oil, denatured.....	gal.	1.15	—	1.17
Palm, Lagos.....	lb.	.07	—	.07
Palm, Niger.....	lb.	.06	—	.06
Peanut oil, crude, tank cars (f.o.b. mill).....	lb.	.12	—	.10
Peanut oil, refined, in bbls.....	lb.	.12	—	.12
Rapeseed oil, refined in bbls.....	gal.	.88	—	.85
Rapeseed oil, blown, in bbls.....	gal.	.88	—	.89
Soya bean oil (Manchurian), in bbls. N. Y.....	lb.	.12	—	.....
soya bean oil, tank cars, f.o.b., Pacific coast.....	lb.	.10	—	.....

### FISH

Light pressed menhaden.....	gal.	\$0.51	—	.....
Yellow bleached menhaden.....	gal.	.53	—	.54
White bleached menhaden.....	gal.	.55	—	.56
Blown menhaden.....	gal.	.61	—	.....
Whale O.I. No. 1, crude, tanks, coast.....	gal.	.45	—	.48

### Refractories

Quotations Remain Same as Previous Report

### Ferro-Alloys

All Prices Quotably Unchanged

### Ores and Semi-finished Products

All f.o.b. New York Unless Otherwise Stated

Bauxite, domestic, crushed and dried.....	net ton	\$6.00	—	\$9.00
Chrome ore, Calif. concentrates, 50% min. Cr <sub>2</sub> O <sub>3</sub> .....	ton	20.00	—	21.00
Chrome ore, 50% Cr <sub>2</sub> O <sub>3</sub> , f.o.b. Atlantic seaboard.....	ton	20.00	—	21.00
Coke, foundry, f.o.b. ovens.....	net ton	7.50	—	7.75
Coke, furnace, f.o.b. ovens.....	net ton	7.25	—	7.50
Fluorspar, gravel, f.o.b. mines, New Mexico.....	net ton	15.00	—	.....
Fluorspar, standard, domestic washed gravel Kentucky and Illinois mines.....	net ton	17.50	—	19.00
Ilmenite, 52% TiO <sub>2</sub> , per lb. ore.....	lb.	.01	—	.01
Manganese ore, 50% Mn, c.i.f. Atlantic seaport.....	unit	.27	—	.27
Molybdenite, 85% MoS <sub>2</sub> , per lb. of MoS <sub>2</sub> , N. Y.....	lb.	.50	—	.....
Monazite, per unit of ThO <sub>2</sub> , c.i.f. Atlantic seaport.....	unit	27.00	—	.....
Pyrites, Spanish, fines, c.i.f. Atlantic seaport.....	unit	.10	—	.11
Pyrites, Spanish, furnace size, c.i.f. Atlantic seaport.....	unit	.12	—	.13
Pyrites, domestic, fines, f.o.b. mines, Ga.....	unit	Nominal	—	.....
Rutile, 95% TiO <sub>2</sub> , per lb. ore.....	lb.	.12	—	.....
Tungsten, scheelite, 60% WO <sub>3</sub> and over, per unit of WO <sub>3</sub> (nominal).....	unit	3.00	—	3.25
Tungsten, wolframite, 60% WO <sub>3</sub> and over, per unit of WO <sub>3</sub> , N. Y. C.....	unit	3.25	—	3.50
Uranium ore (carnotite) per lb. of U <sub>3</sub> O <sub>8</sub> .....	lb.	1.25	—	1.75
Uranium oxide, 96% per lb. contained U <sub>3</sub> O <sub>8</sub> .....	lb.	2.25	—	2.50
Vanadium pentoxide, 99%.....	lb.	12.00	—	14.00
Vanadium ore, per lb. of V <sub>2</sub> O <sub>5</sub> contained.....	lb.	1.00	—	.....
Zircon, washed, iron free, f.o.b. Pablo, Florida.....	lb.	.04	—	.13

### Miscellaneous Materials

Graphite, Ceylon lump, first quality, f.o.b. N. Y.....	lb.	.07	—	.10
Graphite, Ceylon chip.....	lb.	.05	—	.05
Graphite, high grade amorphous crude.....	ton	18.00	—	50.00

All Other Prices Remain Unchanged

### Non-Ferrous Metals

All f.o.b. New York Unless Otherwise Stated

		Cents per Lb
Copper, electrolytic.....	.....	13.75
Aluminum, 98 to 99 per cent.....	.....	19.00-20.00
Antimony, wholesale lots, Chinese and Japanese.....	.....	5.10-5.15
Nickel, ordinary (ingot).....	.....	36.00
Nickel, electrolytic.....	.....	39.00
Nickel, electrolytic, resale.....	.....	32.00-33.00
Nickel, ingot and shot, resale.....	.....	29.00-31.00
Monel metal, shot and blocks.....	.....	32.00
Monel metal, ingots.....	.....	35.00
Monel metal, sheet bars.....	.....	38.00
Tin, 5-ton lots, Straits.....	.....	31.375
Lead, New York, spot.....	.....	5.75
Lead, E. St. Louis, spot.....	.....	5.50-5.60
Zinc, spot, New York.....	.....	5.70
Zinc, spot, E. St. Louis.....	.....	5.35

### OTHER METALS

Silver (commercial).....	oz.	\$0.70
Cadmium.....	lb.	1.20-1.25
Bismuth (500 lb. lots).....	lb.	2.00-2.10
Cobalt.....	lb.	3.00-3.25
Magnesium, ingots, 99 per cent.....	lb.	1.10
Platinum.....	oz.	87.50
Iridium.....	oz.	150.00-170.00
Palladium.....	oz.	55.00-57.50
Mercury.....	75 lb.	54.00-55.00

### Structural Material

The following base prices per 100 lb. are for structural shapes 3 in. by 1/2 in. and larger, and plates 1/2 in. and heavier, from jobbers' warehouses in the cities named:

	New York	Chicago
Structural shapes.....	\$2.58	\$2.58
Soft steel bars.....	2.48	2.48
Soft steel bar shapes.....	2.48	2.48
Soft steel bands.....	2.98	2.98
Plates, 1/2 to 1 in. thick.....	2.58	2.58



# Industrial

## Financial, Construction and Manufacturers' News

### Construction and Operation

#### Arkansas

**LITTLE ROCK**—The Arkansas Foundry Co., manufacturer of gray iron castings, has awarded a contract to the Hermann McCain Construction Co., Little Rock, for the erection of a new 1-story foundry to cost about \$20,000. It will be equipped for a capacity of about 20 tons per day.

#### California

**COLTON**—The Southern California Gas Co. will make extensions and improvements in its local artificial gas plant to cost about \$150,000, increasing the capacity by about 50 per cent. The work will include the installation of two new generators, boilers, purifiers, and auxiliary equipment. H. C. McAllister is division manager.

**PITTSBURG**—The Columbia Steel Co., 503 Market St., San Francisco, has preliminary plans under way for the erection of a large addition to its local plant, estimated to cost in excess of \$1,000,000. W. E. Creed is president.

**ANAHEIM**—A new 1-story foundry will be erected by the Oil Tool Service Mfg. Co. at Santa Ana and Atchison Sts. M. N. Putnam heads the company.

**JOHANNESBURG**—The Standard Oil Co. of California, San Francisco, will commence the immediate erection of a new oil-distributing plant on local site, to be used in connection with its operations in the Bakersfield district.

**SAN DIEGO**—The San Diego Consolidated Gas Co. will construct a new artificial gas container and plant at 12th and K Sts., estimated to cost about \$350,000.

#### Connecticut

**NORWALK**—The Meeker's Iron Foundry Corp. is reported to be planning for the early rebuilding of the portion of its foundry destroyed by fire, June 15, with loss approximating \$60,000.

#### Florida

**JACKSONVILLE**—The Federal Phosphoric Co., Birmingham, Ala., is said to have tentative plans under consideration for the establishment of a new fertilizer manufacturing plant on local site. T. L. Long is in charge.

#### Georgia

**ATLANTA**—Fire, June 10, destroyed a portion of the plant of the Southern Chemical Products Co., 600 Marietta St., with loss estimated at about \$15,000.

**GREENSBORO**—The Southern Cotton Oil Co. is reported to be planning for enlargements in its local plant.

#### Illinois

**ROCK ISLAND**—The Illinois Oil Co., 215 Safety Bldg., has awarded a contract to the R. H. Lorenz Co., Moline, Ill., for the erection of a 3-story plant, 40x150 ft., at 4th Ave and 24th St., estimated to cost about \$135,000, including equipment. Frank J. Welsh is president.

#### Indiana

**ANDERSON**—The Beaver Products Co., Buffalo, N. Y., a subsidiary of the Beaver Board Companies, Inc., recently organized, has acquired the local plant of the Vulcanite Co., used for the manufacture of paper composition roofing, etc. Operations will be continued as heretofore, and it is said that a number of improvements will be made.

#### Kansas

**CANEY**—The C. F. Lutes Window Glass Co. has preliminary plans under consideration for the rebuilding of the portion of its plant destroyed by fire, June 8, with loss estimated at close to \$200,000, including equipment. C. F. Lutes is president and manager.

#### Louisiana

**SWARTZ**—The Ebon Carbon Co. has plans in progress for the removal of its plant, now located at Cedar Grove, La., to Swartz. The Western Carbon Co., Cedar Grove, is also arranging for the removal of its plant to the same new location. It is expected to increase the output at the new works.

**THIBODAUX**—The City Council is considering the installation of a new water purification plant at the municipal waterworks.

**MONROE**—The Southwest Pulp & Paper Co., Joseph G. Mayo, president, 206 Broadway, Norwich, Conn., has perfected its organization under Delaware laws with a capital of \$2,500,000, and will soon commence the erection of its proposed new plant on the Monroe-Columbia Highway, estimated to cost approximately \$250,000, including equipment. The plant will have an initial output of about 100 tons per day.

**NATCHITOCHES**—The Natchitoches Cotton Oil Co. and the Planters' Cotton Oil Mill, the latter with plant at Grand Ecure, La., have been consolidated into a new company, under the first-named name. The Grand Ecure oil mill will be removed to the local site of the Natchitoches company, where a new plant will be constructed, replacing a mill destroyed by fire a number of months ago. New machinery will be installed for considerable increase in capacity. J. H. Williams is president; and W. P. Haynes, general manager.

#### Maryland

**BALTIMORE**—The City Architectural Commission has authorized the preparation of plans for the construction of a new filtration plant at Montebello, to cost close to \$1,000,000, with equipment. It will have a capacity of about 90,000,000 gal. William W. Emmart, 1101 Union Trust Bldg., Baltimore, is architect.

#### Massachusetts

**BOSTON**—K. J. Quinn & Co., Inc., 481 Chelsea St., manufacturer of polishes, etc., has awarded a contract to L. D. Willcutt & Sons, 146 Summer St., for the construction of a new 2-story plant, 30x60 ft., estimated to cost about \$25,000.

#### Missouri

**COLUMBIA**—The City Council is arranging for the purchase of the plant of the Columbia Gas Co., for operation as municipal property. A bond issue of \$100,000 will be voted to provide for the acquisition, and proposed additions and improvements.

#### New Jersey

**GARFIELD**—The Heyden Chemical Co. of America, Inc., 135 William St., New York, N. Y., has awarded a contract to the Gabler Construction Co., 402 Hudson St., New York, for the construction of a new 5-story plant at Garfield, to cost about \$90,000.

**TRENTON**—The New Jersey Porcelain Co., Pennsylvania Ave., has filed plans for the construction of a new 1-story plant.

**MAURER**—The United Lead Co., 111 Broadway, New York, N. Y., has preliminary plans under way for the rebuilding of the portion of its plant at Maurer, near Perth Amboy, destroyed by fire on May 16, with loss reported in excess of \$1,000,000.

**HOBOKEN**—The Fisher-Sweeny Bronze Co., 1301 Grand St., will take bids at once for the construction of a new 1- and 2-story foundry, to replace the portion of its works recently destroyed by fire. It will cost close to \$80,000. Lockwood, Greene & Co., 101 Park Ave., New York, is architect.

#### New York

**RETSEF**—The Retsef Mining Co. has awarded a contract to the John W. Cowper Co., Fidelity Bldg., Buffalo, N. Y., for the construction of its proposed new 1- and 2-story plant for salt mining and refining, estimated to cost in excess of \$1,000,000, including machinery. T. F. Courthope is engineer, for the company.

**NEW YORK**—The Super-Saftee Ink Corp., 219 West 27th St., manufacturer of special non-corrosive inks, chemically treated, is

disposing of a preferred stock issue totaling about \$250,000, the proceeds to be used for general expansion. Preliminary plans are under way for the establishment of branch plants at Boston, Chicago, St. Louis, Mo., Atlanta, Ga., and other cities.

**NORTH TONAWANDA**—The Board of Public Works will commence the immediate construction of a new filtration plant on Tonawanda Island for the municipal water works, to cost about \$250,000, including equipment. It is proposed to have the plant ready for service early in the coming year.

#### Ohio

**CLEVELAND**—The Diamond Glass Co., 1447 West 25th St., is said to be planning for the immediate rebuilding of the portion of its local plant destroyed by fire, June 5, with loss approximating \$300,000, including machinery.

**CLEVELAND**—The Crucible Steel Castings Co., Champlain Ave. and Canal Road, has plans under way for the construction of a new 1-story foundry on Almira Ave. near West 82nd St., estimated to cost close to \$100,000, with equipment. The George S. Rider Co., 612 Century Bldg., is engineer.

**DENNISON**—The local plant of the Dennison Fireclay & Brick Co. has been acquired by John Scott and Walter Moore, Uhrichsville, O., from C. A. Albaugh, trustee in bankruptcy. The new owners will reorganize the company and place the plant in operation at once. A number of extensions and improvements will be made.

#### Oregon

**GRESHAM**—The Pacific Malleable Iron Co. is planning for the immediate construction of a new 1-story foundry on local site.

#### Pennsylvania

**FRANKLIN**—The Atlantic Refining Co., 3144 Passyunk Ave., Philadelphia, is said to have plans under way for the rebuilding of the portion of its local plant, operated under the name of the Eclipse Oil Works, recently destroyed by fire, with loss in excess of \$90,000, including equipment.

**PHILADELPHIA**—The H. H. Barton & Son Co., 109 South 3rd St., manufacturer of abrasive papers and materials, will commence the immediate erection of a new building at its plant on Bleigh St., estimated to cost about \$25,000. The construction contract has been let to the Roydhouse Arey Co., Fidelity Bldg.

**HIGH SPIRE**—The Keystone Carbonic Gas Co., Inc., manufacturer of commercial oxygen, hydrogen, etc., will commence the immediate erection of its proposed new local plant for the manufacture of carbonic gas, etc. The company recently acquired a local site.

#### Tennessee

**GRAYSVILLE**—The Dixie Coal, Lime & Clay Products Co. has plans under way for the construction of a local plant, comprising a number of 1-story buildings, for the manufacture of brick and other burned clay products. It will be equipped for initial output of about 100,000 bricks per day. O. E. Thomas is president.

#### Texas

**ELECTRA**—The Council will commence the immediate construction of a new water-purification plant at the municipal water works, with capacity of about 500 gal.

**DALLAS**—The Dallas Gas Co. has preliminary plans under way for extensions and improvements in its plant and system, to cost in excess of \$300,000. Henry C. Morris is vice-president and general manager.

#### Virginia

**WINCHESTER**—The American Gas Improvement Co., 26 Cortlandt St., New York, has acquired the local plant of the Winchester Gas Co., and has plans under way for extensions and improvements. The capacity will be increased with the erection of a new unit on local property recently acquired.

#### West Virginia

**HOOVERVILLE**—The Muddlety Valley Clay Products Co., recently organized, will soon commence the construction of a new local plant for the manufacture of brick, tile and kindred burned clay products. The initial works will comprise two 1-story structures, each about 25x120 ft. Porter Herold is secretary.

#### Wisconsin

**FORT ATKINSON**—The Fort Atkinson Tanning Co. is considering preliminary plans

for the rebuilding of the portion of its leather plant, destroyed by fire, June 11, with loss estimated at close to \$100,000, including equipment. The plant occupies about 4 acres of land and five buildings were destroyed.

**MILWAUKEE**—The Rundle Mfg. Co., 27th St. and Cleveland Ave., has commenced the construction of a new 1-story building, 60x200 ft., at its iron works, to be equipped as a foundry. It will cost about \$50,000.

### Wyoming

**CASPER**—The Texas Co., 17 Battery Place, New York, N. Y., is completing plans for the construction of its proposed new local oil refinery on tract of about 500 acres of land, and will commence construction at an early date. It is proposed to have the initial unit ready for operation late in the fall. The works will have a capacity for handling about 5,000 bbl. of crude oil per day, and will include complete byproducts departments for the recovery of gasoline, naphtha and other products.

### Canada

**NELSON, B. C.**—The Consolidated Mining & Smelting Co. of Canada, operating large plants at Nelson and Trail, B. C., is completing plans for the construction of a new concentrating plant, estimated to cost in excess of \$1,000,000, with machinery. A power plant will also be constructed. S. G. Blaylock is general manager.

**MONTREAL, QUE.**—The Dominion Oxygen Co., Ltd., has recently acquired the property of the National Electric Products Co., Ltd., manufacturer of similar commercial oxygen, etc., and has plans under way for plant enlargements and improvements. It is said that a number of branch works will be located in different important Canadian cities. The business of the acquired company will be merged with the Dominion organization.

### Mexico

**MEXICO CITY**—The San Rafael Paper Co., operating a local mill, has plans nearing completion for the erection of a new plant at Merida, Yucatan, for the manufacture of pulp products under a special process. Leaves of the henequin plant will be used as a source of raw material.

## New Companies

**THE BETHEL TANNING CO.**, Bethel, Conn., has been incorporated with a capital of \$50,000, to manufacture leather products. The incorporators are F. H. Judd, H. E. Mackenzie and David Lane, all of Bethel.

**THE W. J. WIX & SONS CO.**, 104 Market St., Camden, N. J., has been incorporated with a capital of \$50,000, to manufacture paints, varnishes, etc. The incorporators are W. J. Wix, Sr. and Jr., and J. C. Wix.

**THE CRYSTAL & SCIENTIFIC GLASS PRODUCTS CO.**, New York, N. Y., care of T. F. Daniels, representative, South Orange, N. J., has been incorporated with a capital of \$100,000, to manufacture special glassware specialties. The incorporators are F. and Z. Kafka, and G. C. Volz.

**THE BI-CHEMICAL CO.**, Memphis, Tenn., has been incorporated with a capital of \$5,000, to manufacture chemicals and chemical byproducts. The incorporators are H. S. Austin, Karl Wood and R. W. Snell, all of Memphis.

**THE AETNA ABRASIVE CO.**, 1462 West Ohio St., Chicago, Ill., has been incorporated with a capital of \$5,000, to manufacture emery wheels and other abrasive products. The incorporators are Anton S. Lux, Frank Cass and John J. Leskee.

**THE BOLIVAR FOUNDRY CO.**, Bolivar, N. Y., care of Elias & Bliss, Bolivar, has been incorporated with a capital of \$50,000, to manufacture iron, steel and other metal castings. The incorporators are W. A. Sherwood, H. J. McIntyre and W. J. Brennen, Bolivar.

**THE NEW BEDFORD TILE PRODUCTS CO.**, New Bedford, Mass., has been incorporated with a capital of \$100,000, to manufacture tile and other ceramic products. Elie Blanchette is president; Francois X. Girard, vice-president; and Urie LeClair, 1020 South Water St., New Bedford, treasurer.

**THE ATLANTA TIRE & RUBBER CO.**, care of Franklin L. Mettler, 832 Market St., Wilmington, Del., representative, has been incorporated under state laws with capital of \$500,000, to manufacture tires and other rubber products.

**THE LUCKERT-KLEB-GERARD MFG. CO.**, 61 Wheeler Point Road, Newark, N. J., has filed notice of organization to manufacture washing fluids and other chemical

specialties. The company is headed by William Luckert, Louis Kleb and Nicholas Gerard.

**THE OHIO REFRACTORIES CO.**, Portsmouth, O., has been incorporated with a capital of \$100,000, to manufacture firebrick and other refractory products. The incorporators are M. K. Hitchcock and H. W. Heer, both of Portsmouth.

**THE KEENE TANNING CO.**, Boston, Mass., has been chartered under state laws to manufacture leather products. Nathan Gans, 13 Lincoln St., Cambridge, Mass., is president and treasurer; Mahlon H. Anderson is vice-president.

**THE MARINE RUBBER CO.**, care of the Delaware Registration Trust Co., 900 Market St., Wilmington, Del., representative, has been incorporated under state laws with a capital of \$1,250,000, to manufacture special armored rubber products.

**THE CHILDERS BROTHERS CHEMICAL CO.**, Lake Wales, Tex., has been incorporated with a capital of \$10,000, to manufacture chemicals and chemical byproducts. Reuben R. Childers is president; George E. Childers, vice-president; and P. M. Childers, secretary, all of Lake Wales.

**WILLIAM W. WOOD & CO., INC.**, care of the Corporation Trust Co. of America, du Pont Bldg., Wilmington, Del., representative, has been incorporated under Delaware laws with capital of \$750,000, to manufacture leather products.

**THE WYOMISSING CEMENT PRODUCTS CO.**, North Wyomissing Heights, Wyomissing, Pa., has been incorporated with a capital of \$10,000, to manufacture cement specialties. B. F. Willson, Wyomissing, is treasurer.

**THE SUPERIOR OIL CORP.**, Nashville, Tenn., has been incorporated with a capital of \$25,000, to manufacture petroleum products. The incorporators are H. B. Hammond, E. W. Turnley and C. M. Carroll, all of Nashville.

## Industrial Developments

**CERAMIC**—The Pittsburg Clay Products Co., Pittsburgh, Pa., is operating at full capacity at its plants at Walkers' Mills and Beaver Falls, Pa., for the manufacture of face brick. The present output is running to 1,500,000 bricks per month, and it is expected to increase this production to about 2,000,000 bricks at an early date.

All face brick manufacturing plants in the Birmingham, Ala., district are operating on a full-time schedule. The orders taken in May are the largest for any month since the close of the war.

**Sankey Brothers**, Pittsburg, Pa., manufacturers of brick, are running at a full-capacity schedule at their local plant, comprising 6 kilns, with average of 300,000 bricks to the kiln.

**The Thomas Maddock's Sons Co.**, Trenton, N. J., manufacturer of sanitary ware, is operating on a full time, full-capacity schedule. Incoming orders are exceeding the output.

**OIL**—The Wortham Refining Co., Wortham, Tex., has placed its new refining plant in operation, recently completed, under a day and night schedule. The refinery will use crude oil from the Wortham, Currie and Mexia fields.

**The Milliken Refining Co.**, St. Louis, Mo., has resumed operations at its oil refinery at Arkansas City, Kan., following a suspension for about a year past.

**RUBBER**—The Excel Rubber Co., Wadsworth, O., has been reorganized, following the termination of a receivership, and the plant placed in operation. It is proposed to develop a capacity output at once. The plant specializes in tires and belts, and has been closed for about 6 months past.

**The Goodyear Tire & Rubber Co.**, Akron, O., has adopted an 8-hour shift at its plant, replacing a 10-hour day working basis, allowing employees the same wages for the shorter day. The plant is on a capacity basis.

**The United States Rubber Co.**, New York, N. Y., is arranging for the resumption of operations at its Candee plant at New Haven, Conn., on July 5, following a suspension since May 1.

The plant of the Avalon Rubber Co., Barberton, O., has been sold by the receiver to a syndicate, recently formed, and will be used for another line of manufacture. Production of rubber will be carried out as a subsidiary feature of operations.

**The Studebaker-Wulff Rubber Co.**, Marion, O., has adopted a night shift at its plant, in addition to regular day production. Incoming orders exceed the capacity of the plant.

**IRON AND STEEL**—The Thomas Furnace Co., Milwaukee, Wis., is planning to blow in its furnace for pig-iron production early in July.

The Donaldson Iron Co., Emaus, Pa., is making ready for operations at its No. 2 foundry, and will place the plant in service at an early date. With this unit on the production list, the company will be operating at full capacity.

The Reading Iron Co., Reading, Pa., has advanced the wages of puddlers at its Columbia, Pa., works from \$6.50 to \$7 a ton. The pay of laborers has also been increased.

The Petroleum Iron Works, Petroleum, Pa., is arranging to advance production about 20 per cent at its plant, following the booking of several large orders.

Following part-time operation for about a year past, the Buffalo Steel Co., Buffalo, N. Y., has resumed production on a full-capacity basis, with day and night working forces.

The Shelby Iron Co., Birmingham, Ala., has resumed operations at its Shelby, Ala., stack. The company is said to have booked a good volume of orders for its charcoal iron production.

The Minnesota Steel Co., Duluth, Minn., has increased production to a 60 per cent operating basis, and will add about 1,000 men to the working force at once.

The Carpenter Steel Co., Reading, Pa., has advanced the wages of laborers at its mills from 24 to 27 cents an hour. All other workers at the plant will also receive a proportionate increase, effective July 1.

The Guide Plate Bar Mills is planning to blow in another furnace at its Birmingham, Ala., works. The stack will be used for manganese production.

**MISCELLANEOUS**—The Golden Rod Mining & Smelting Co., Cardin, Okla., will resume operations at once at its No. 7 mill, following a shut-down for more than a year past. The mill is one of the largest concentrating plants in this section, with a rated capacity of about 1,000 tons a day.

The Cleveland Iron Co., Houghton, Mich., has resumed operations on a full-time basis at its iron-ore properties in this district, following a half-time operating schedule for the past year.

Leather tanneries throughout the country devoted to the production of upholstery leather are operating on a full-time basis, with heavy orders booked ahead.

The Corn Products Refining Co., New York, N. Y., has arranged for the resumption of operations at its Edgewater, N. J., refinery, following a suspension from last April. Other plants of the company are now running on a basis of about 65 per cent of capacity.

The Bastrop Pulp & Paper Co., Morehouse Parish, near Monroe, La., has commenced operations at its new local mill, following a curtailment for a number of months. It is proposed to develop capacity output at an early date.

## Coming Meetings and Events

**AMERICAN CERAMIC SOCIETY** will hold a summer excursion meeting to Rochester, Montreal, Ottawa, Kingston, Toronto, Hamilton, Niagara Falls and Buffalo, Aug. 13-19.

**AMERICAN CHEMICAL SOCIETY** will hold its fall meeting in Pittsburgh, Pa., Sept. 6 to 9.

**AMERICAN ELECTROCHEMICAL SOCIETY** will hold its fall meeting in Montreal, Sept. 21, 22 and 23. Headquarters will be at the Windsor Hotel.

**AMERICAN SOCIETY FOR STEEL TREATING** will hold its International Steel Exposition and Convention in the General Motors Bldg., Detroit, Mich., Oct. 2 to 7.

**AMERICAN SOCIETY FOR TESTING MATERIALS** is holding its twenty-fifth annual meeting June 26 to July 1, at Atlantic City, N. J. Headquarters are at the Chalfonte-Haddon Hall Hotel.

**ANNUAL SAFETY CONGRESS OF THE NATIONAL SAFETY COUNCIL** will be held in Detroit, Mich., Aug. 28-Sept. 2.

**INTERNATIONAL UNION OF PURE AND APPLIED CHEMISTRY** will hold a meeting at Lyons, France, June 27 to 30.

**NATIONAL EXPOSITION OF CHEMICAL INDUSTRIES (EIGHTH)** will be held in New York Sept. 11-16.

**NATIONAL EXPOSITION OF POWER AND MECHANICAL ENGINEERING** will be held at the Grand Central Palace Dec. 7-13, with the exception of the intervening Sunday.

**NEW JERSEY CHEMICAL SOCIETY** will meet at Stettens Restaurant, 842 Broad St., Newark, N. J., the second Monday of every month.





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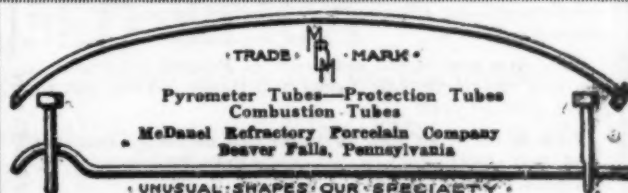
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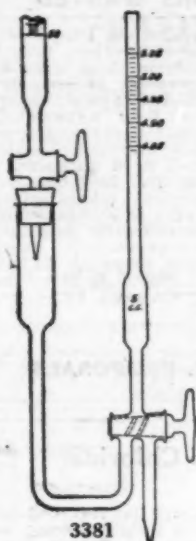
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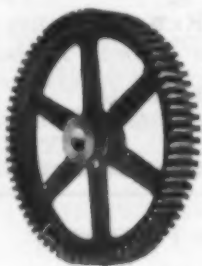


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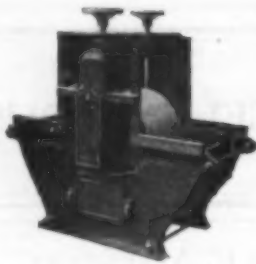


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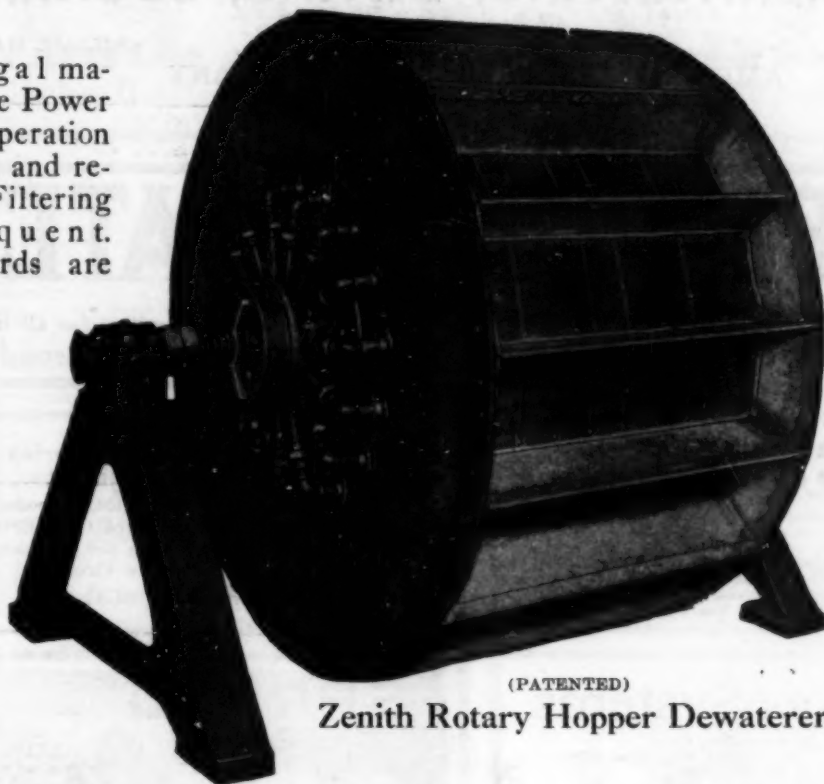
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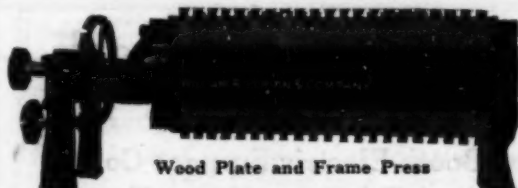


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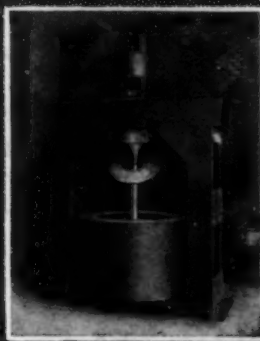


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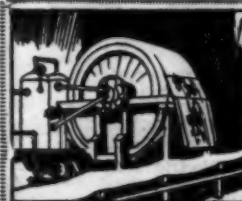
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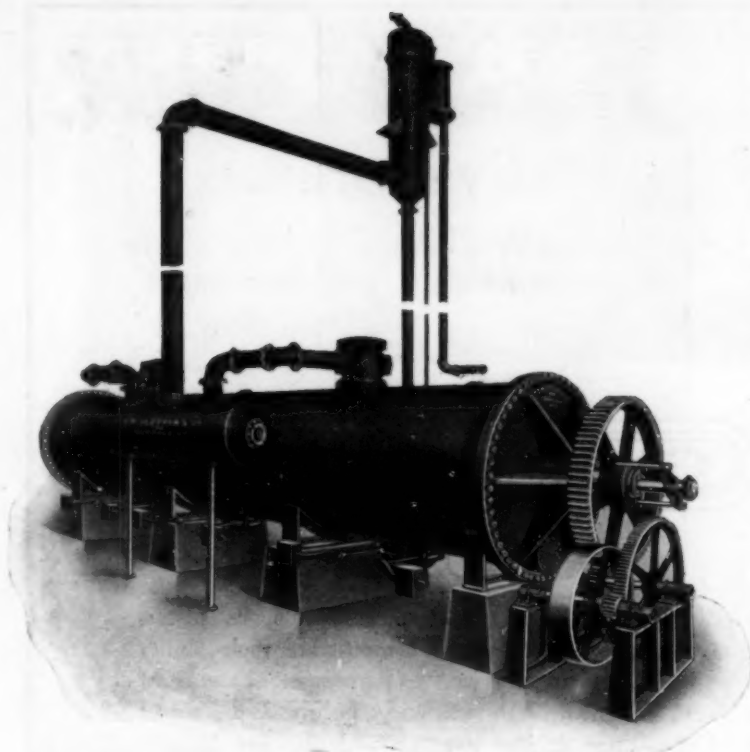
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for materials which may be agitated.

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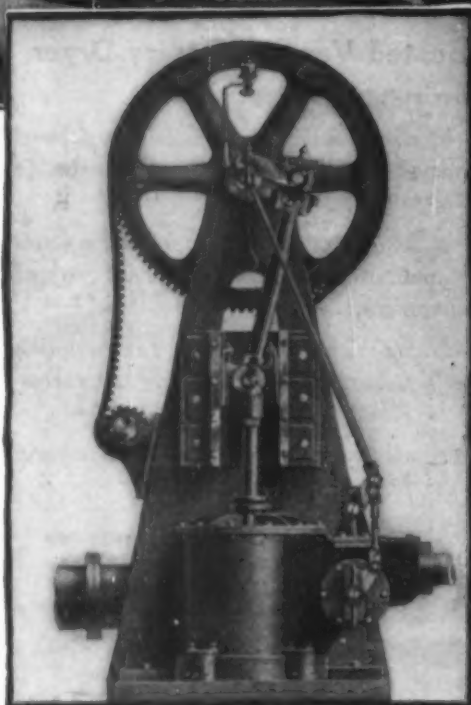


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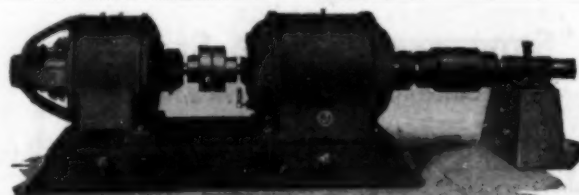
has been perfected to give the greatest output with least power and wear of any pulverizer even on the hardest and toughest materials.

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*Compact*—occupy very little space, even for reductions of 200 to 1.  
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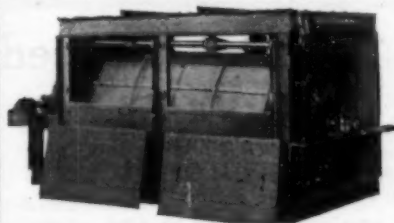
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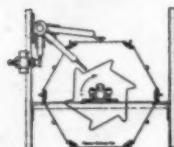


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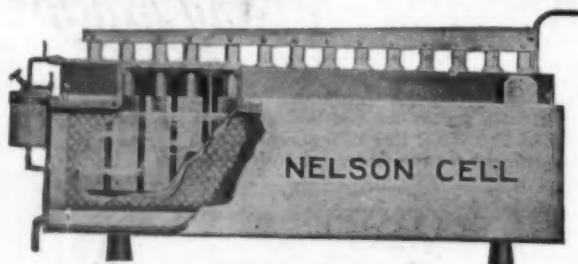
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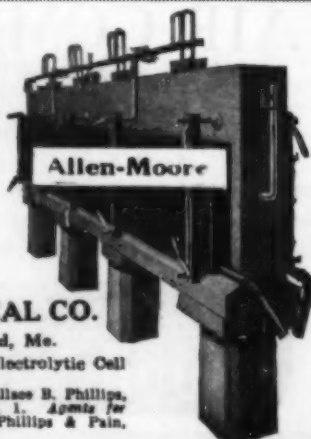
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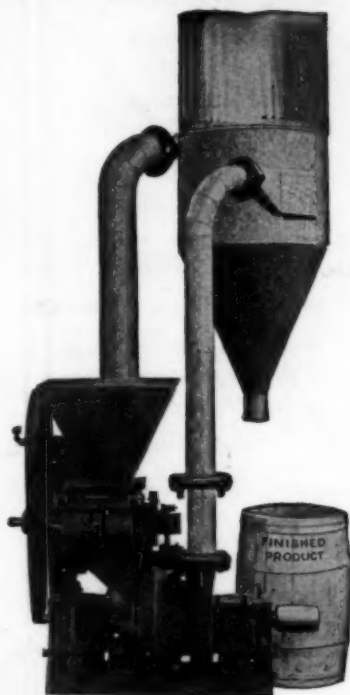
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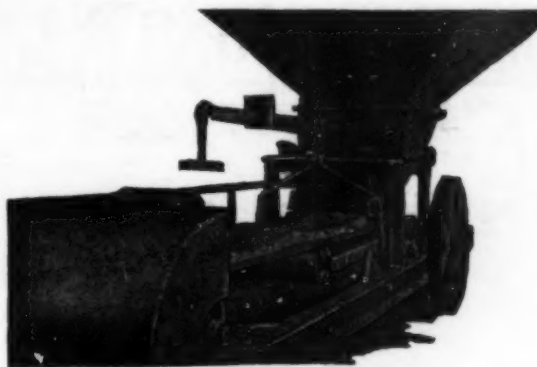


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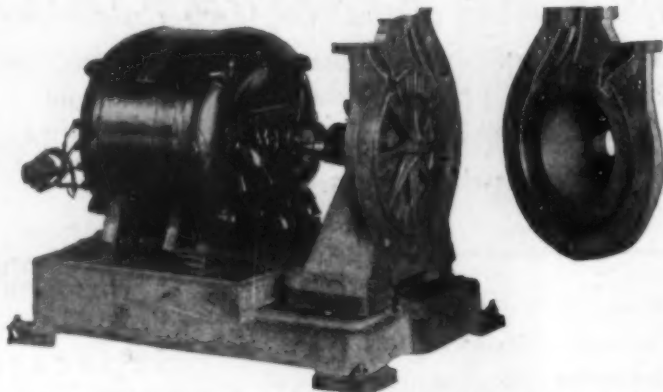
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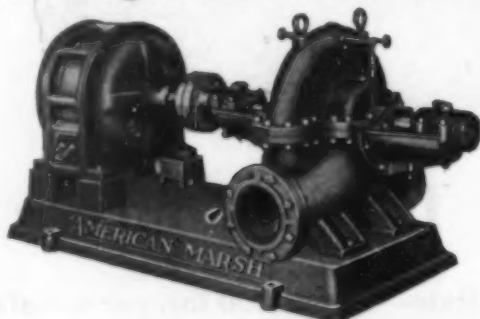
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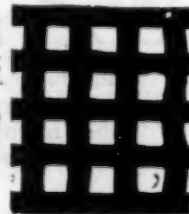
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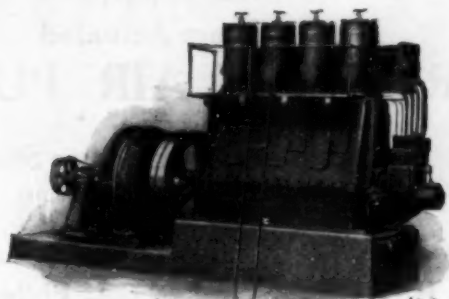
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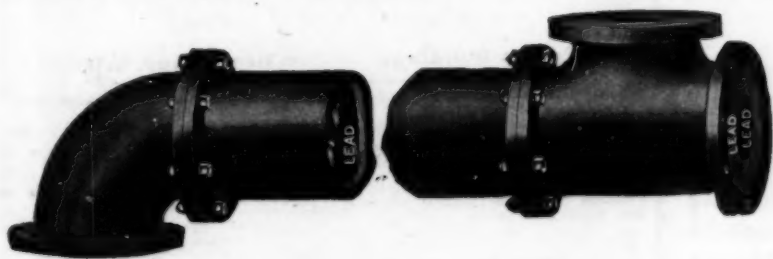


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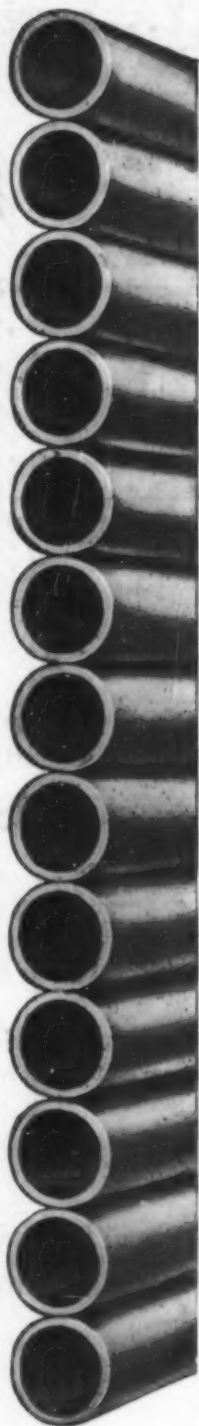
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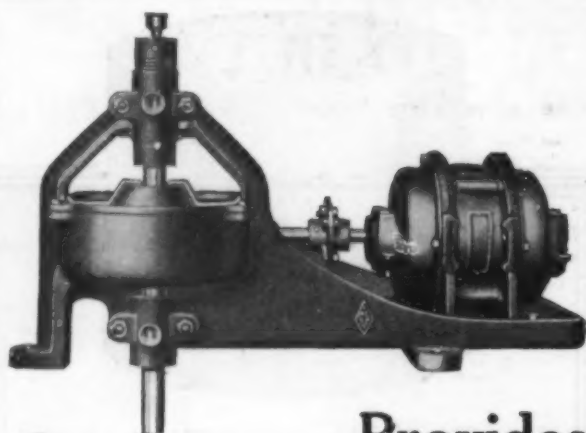
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Direct Connected  
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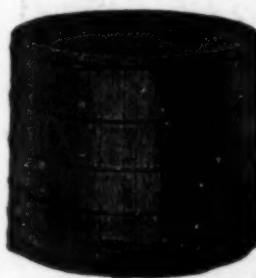


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Commercial Solvents Corp.

**Alkalies**  
Roessler & Hasslacher Co.

**Alloys, Special**  
See Metals & Alloys  
Baker & Co.  
Calorizing Co. of Pgh.  
Scovill Mfg. Co.  
Titanium Alloy Mfg. Co.

**Ammeters**  
Weston Elec. Inst. Co.

**Analytical Apparatus**  
Ainsworth, Wm., & Sons  
Braun Corp.  
Braun-Knecht-Helmann Corp.  
Denver Fire Clay Co.  
Elmer & Amend  
Hoskins Mfg. Co.  
Kaufman-Lattimer Co.

**Asbestos Products: Filters, Diaphragm, Yarns, Cords, Fabrics, Felts Roofings, Insulations**  
Johns-Manville, Inc.

**Ash Handling Machinery**  
Green Eng. Co.  
Jeffrey Mfg. Co.

**Autoclaves**  
Bethlehem Fdy. & Mach. Co.  
Devine Co., J. P.  
Kellogg Co., M. W.  
Stokes Mach. Co., F. J.  
Vulcan Iron Works  
United Lead Co.

**Balances and Weights**  
Ainsworth, Wm., & Son  
Elmer & Amend

**Barometers**  
Taylor Instrument Co.

**Barrels, Steel**  
Petroleum Iron Works

**Barrels, Wood**  
Sandusky Cooperage & Lumber Co.

**Bars, Iron and Steel**  
Harrisburg Pipe & Pipe Bending Co.  
Ryerson & Son

**Battery Plates & Carbon**  
Speer Carbon Co.

**Belt Conveyors**  
See Conveying Mach.  
Bartlett & Snow Co.  
Caldwell, H. W., & Son  
Goodrich Rubber Co.  
Jeffrey Mfg. Co.

**Belting**  
Goodrich Rubber Co.

**Belting, Silent Chain**  
Morse Chain Co.

**Bins, Steel and Concrete**  
Petroleum Iron Works

**Blowers, Fan or Rotary**  
Buffalo Forge Co.  
Chicago Flexible Shaft Co.  
Connorsville Blower Co.  
Duriron Co.  
Nash Eng. Co.

**Boiler Covering**  
Celite Products Co.

**Boiler Insulation**  
Johns-Manville, Inc.

**Boiler Meters**  
See Meters, Flow, Air, etc.

**Boiler Tubes and Fittings**  
Crane Co.  
Ryerson & Son  
Vogt Mach. Co., H.

**Bollers**  
Babcock & Wilcox  
Vogt Mach. Co., H.

**Books, Technical**  
McGraw-Hill Book Co.

**Brass Goods**  
Scovill Mfg. Co.

**Brick & Tile, Acid Proof**  
Chemical Construction Co.  
Harbison-Walker Refrac. Co.  
Knight, M. A.

**Brick, Blocks, Powder Insulating**  
Celite Products Co.

**Brick and Clay, Fire**  
Denver Fire Clay Co.  
Dixon Crucible Co., J.  
Green Eng. Co.

**Brimstone**  
Union Sulphur Co.

**Bronze, Acid Resisting**  
Stebbins Engr. & Mfg. Co.

**Bucket Elevators**  
Caldwell, H. W., & Son Co.  
Jeffrey Mfg. Co.

**Buckets, Clamshell and Dragline**  
Blaw-Knox Co.  
Brown Hoisting Machy. Co.  
Orton & Steinbrenner Co.

**Building Materials**  
Robertson Co., H. H.

**Buildings, Steel**  
Blaw-Knox Co.

**Burners, Gas and Oil**  
Chicago Flexible Shaft Co.  
Maxon Furnace & Eng. Co.  
Parks-Cramer Co.

**Butanol (Normal Butyl Alcohol)**  
Commercial Solvents Corp.

**Calorimeters**  
Standard Calorimeter Co.

**Carbon Dioxide Gas, CO<sub>2</sub>**  
Liquid Carbonic Co.

**Carbon, Refining, Purifying, Decolorizing, Deodorizing**  
Darco Corp.

**Carboy Stoppers, Stoneware**  
See Stoneware, Chem.

**Cars, Tank**  
Petroleum Iron Works

**Casseroles**  
Coors Porcelain Co.

**Castings, Acid Proof**  
Bethlehem Fdy. & Mach. Co.  
Pacific Fdy. Co.  
Standard Calorimeter Co.

**Castings, Bronze & Brass**  
Scovill Mfg. Co.

**Castings, Chemical**  
Bethlehem Fy. & Mch. Corp.  
Buffalo Fdry. & Mach. Co.  
Duriron Co.  
Sperry, D. E., & Co.

**IF what you are looking for is not listed, write us : : :**

**Castings, Iron**  
Bethlehem Fdy. & Mach. Co.  
Vogt Mach. Co., H.

**Castings, Special and Chilled**  
Vulcan Iron Works

**Caustic Pots**  
Bethlehem Fdy. & Mach. Co.  
Buffalo Fdry. & Mach. Co.

**Caustic Soda and Chlorine Plants**  
Electron Chemical Co.  
Glamorgan Pipe & Fdry. Co.  
Pennsylvania Salt Mfg. Co.  
Warner Chemical Co.

**Causticizing Apparatus**  
Dorr Co.  
Glamorgan Pipe & Fdry. Co.  
Zaremba Co.

**Cement, Acid Proof**  
Chemical Const. Co.  
Knight, M. A.

**Cement Cloth**  
Ludlow-Saylor Wire Co.

**Cement, Furnace**  
Dixon Crucible Co., J.

**Cement, High Temperature**  
Celite Products Co.  
Johns-Manville, Inc.

**Cement, Insulating**  
Celite Products Co.

**Centrifugals**  
American Tool & Mach. Co.  
Tolhurst Machine Works  
Union Steam Pump Co.

**Chemical Stoneware, Acid Proof**  
See Stoneware, Chemical, etc.

**Chemicals**  
Central Scientific Co.  
Daigger, A., & Co.  
Denver Fire Clay Co.  
Duval D'Adrian, A. L.  
Elmer & Amend  
Kaufman-Lattimer Co., The  
Roessler & Hasslacher Chem. Co.

**Chemists, Manufacturing**  
Pennsylvania Salt Mfg. Co.  
Roessler & Hasslacher Chem. Co.

**Clarifiers**  
Colorado Iron Works Co.

**Classifiers**  
Dorr Co., The

**Coal Meters**  
See Meters, Flow, Air, Etc.

**Coils and Bends**  
Crane Co.  
Harrisburg Pipe & Pipe Bending Co.  
United Lead Co.

**Compressors, Air or Gas**  
Ingersoll-Rand Co.  
Nash Engineering Co., The  
Union Steam Pump Co.

**Concentrators, Sulphuric Acid & Sludge Acid**  
Chemical Construction Co.

**Condensers, Barometric, Surface or Jet**  
American Steam Pump Co.  
Buffalo Fdy. & Mach. Co.  
Devine Co., J. P.  
Ingersoll-Rand Co.  
Union Steam Pump Co.  
Westinghouse Elec. & Mfg. Co.

**Wheeler, C. H. Mfg. Co.**  
Worthington Pump & Machy Corp.

**Containers, Heat Treating**  
Hoskins Mfg. Co.

**Controllers, Temperature**  
Crane Co.  
Foxboro Co.  
Powers Regulator Co.

**Conveying Machinery**  
Guarantee Const. Co.

**Conveyors, Pneumatic**  
Green Eng. Co.  
Guarantee Construction Co.

**Conveyors, Portable**  
Jeffrey Mfg. Co.

**Cooperage Stock**  
Sandusky Cooperage & Lumber Co.

**Couplings, Flexible Shaft**  
Chicago Flexible Shaft Co.  
Crane Co.  
Harrisburg Pipe & Pipe Bending Co.

**Cranes, Locomotive**  
Brown Hoisting Machy. Co.  
Orton & Steinbrenner Co.

**Crucibles, Graphite**  
Bartley Crucible Co.  
Dixon Crucible Co., J.

**Crucibles, Industrial**  
Bartley, J. Crucible Co.  
Dixon Crucible Co., J.

**Crucibles, Laboratory**  
American Platinum Works

**Crystallizing**  
See Pans, Vacuum

**Cylinders, Artesian Well**  
American Well Works

**Decolorants**  
Darco Corp.

**Dehydrators, Centrifugal**  
Tolhurst Mach. Works

**Digesters**  
Blaw-Knox Co.

**Disintegrators**  
Jeffrey Mfg. Co., The  
Stedman's Fdy. & Mach. Works

**Distilling Mach. and Apparatus**  
Barnstead Still & Sterilizer Co.  
Devine Co., J. P.  
Duriron Co.  
Koven, L. O., & Bro.  
Zaremba Co.

**Draft Apparatus, Forced & Induced**  
Sturtevant Co., B. F.

**Drills, Portable, Air, Electric**  
Ingersoll-Rand Co.

**Drills, Rock**  
American Well Works

**Drives, Silent Chain**  
Morse Chain Co.

**Drop Forge Fittings**  
Crane Co.  
Vogt Mach. Co., H.

**Drums, Steel**  
Petroleum Iron Works

**Dryers**  
Proctor & Schwartz  
Buffalo Fdry. & Mach. Co.

**Dryers, Centrifugal**  
Tolhurst Machine Works

**Dryers, Rotary, Welded**  
American Process Co.

**Dryers, Vacuum**  
Buffalo Fdy. & Mach. Co.  
Devine Co., J. P.  
Sleeper & Co., O. S.  
Stokes Mach. Co., F. J.

**Drying Apparatus**  
Buffalo Forge Co.

**Drying Machinery**  
American Process Co.  
Buckeye Dryer Co.  
Buffalo Fdry. & Mach. Co.  
Phila. Drying Mach. Co.  
Proctor & Schwartz, Inc.  
Vulcan Iron Works

**Dust Collecting Systems and Engines**  
Allis-Chalmers Mfg. Co.  
Raymond Bros. Imp. P. Co.  
Fleisher & Co., W. L.

**Dynamos and Motors**  
Jantz & Leist Elect. Co.  
Westinghouse Elec. & Mfg. Co.

**Electric Supplies**  
Johns-Manville, Inc.  
Westinghouse Elec. & Mfg. Co.

**Electrolytic Cells**  
Electron Chem. Co.  
Warner Chemical Co.

**Electrolytic Oxygen and Hydrogen Generators**  
Shriver & Co., T.

**Electroplating Dynamos; Supplies**  
Jants & Leist Elect. Co.

**Electroplating Salts**  
Roemer & Hasselacher Chem. Co.

**Enamelled Apparatus, Acid Resisting**  
Elvira Enamelled Prod. Co. Pfaudler Co.

**Engineers, Chemical, Consulting, Metallurgical**  
(See Prof. Divs.)  
Dorr Co., The  
Duval D'Adrian, A. L.  
Fleisher & Co., W. L.  
Guarantee Cons. Co.

**Engineers, Construction**  
Chemical Construction Co. Research Corp.

**Engineers, Filtration**  
Industrial Filtration Corp.

**Engineers Combustion**  
Maxon Furnace & Eng. Co.

**Engineers, Furnace**  
Amer. Ind. Furnace Corp.  
Chicago Flexible Shaft Co.  
Hagan, Geo. J., Co.

**Engines, Gas, Gasoline, Oil and Steam**  
Fairbanks, Morse & Co.  
Ingersoll-Rand Co.

**Evaporating Dishes**  
Elvira Enamelled Prod. Co.

**Evaporators**  
Baker Sons & Perkins Co.  
Buffalo Fdy. & Mach. Co.  
Devine Co., J. F.  
Kestner Evaporator Co.  
Koven, L. O., & Bro.  
Lancaster Iron Works  
Pfaudler Co.  
Sleeper & Co., O. S.  
Sperry, D. R., & Co.  
Stokes Mach. Co., F. J.  
Zaremba Co.

**Exhausters, Rotary Positive Gas**

Connersville Blower Co.  
Nash Engineering Co.

**Extraction Plants**  
Ingersoll-Rand Co.

**Extractors**  
Buffalo Fdy. & Mach. Co.  
Devine Co., J. F.  
Koven, L. O., & Bro.

**Extractors, Centrifugal**  
Tolhurst Machine Works

**Fans**  
Phila. Drying Mch. Co.  
Proctor & Schwartz, Inc.  
Raymond Bros. Imp. F. Co.  
Sturtevant Co., B. F.  
Vulcan Iron Works  
Westinghouse Elec. & Mfg. Co.

**Faucets, Stoneware**  
(See Stoneware, Chem. etc.)

**Feeders**  
Webster Mfg. Co.

**Ferro-Alloys**  
Leavitt & Co., C. W.  
Titanium Alloy Mfg. Co.

**Fibre Products (Conduits, etc.)**  
Johns-Manville, Inc.

**Filter Cloth**  
Shriver & Co., T.

**Filter Cloth, Metallic**  
Ludlow-Saylor Wire Co.

**Filter Paper**  
Central Scientific Co.

**Filter, Porous Porcelain**  
Coors Porcelain Co.

**Filter Presses**  
Colorado Iron Works Co.  
Koven, L. O., & Bro.  
Oliver Continuous Filter Co.  
Perrin & Co., W. R.  
Shriver, T., & Co.  
Sperry, D. R., & Co.

**Filtering Materials**  
Celite Products Co.  
Johns-Manville, Inc.

**Filters, Rotary Continuous**  
Colorado Iron Works Co.  
Glamorgan Pipe & Fdy. Co.  
Industrial Filtration Co.  
Oliver Continuous Filter Co.  
United Filters Corp.

**Filters, Oil**  
Industrial Filtration Corp.

**Filters, Suction, Acid-Proof**  
Industrial Filtration Corp.  
Knight, M. A.

**Flooring, Metallic**  
Irving Iron Works

**Flooring, Ventilating**  
Irving Iron Works

**Floor Grating**  
Irving Iron Works

**Flooring, Industrial**  
Johns-Manville, Inc.

**Flotation Apparatus**  
Colorado Iron Works Co.

**Furnaces, Industrial (Assay, Melting, Caustic Soda, Heat Treating, Oil, Gas and Coke, Muffle, Porcelain-encasing, Roasting and Smelting)**

Allis-Chalmers Mfg. Co.  
American Industrial Fur-  
Colorado Iron Works Co.  
Chicago Flexible Shaft Co.  
Detroit Electric Furnace Co.  
Electric Furnace Const. Co.  
Holcroft & Co.  
Hoskins Mfg. Co.  
Pacific Fdy. Co.

**Furnaces, Electric**  
Booth Electric Furnace Co.  
Electric Furnace Const. Co.  
Westinghouse Elec. & Mfg. Co.

**Furnaces, Electric Lab'y**  
Booth Electric Furnace Co.  
Elmer & Amend Co.  
Electric Heating App. Co.  
Hoskins Mfg. Co.

**Fused Silica**  
General Ceramics Co.

**Gas Machines**  
Morgan Const. Co.

**Gas Producers**  
Flinn & Dreffain Co.  
Hagan Co., Geo. F.  
Morgan Construction Co.

**Gas Valves**  
Morgan Const. Co.

**Gaskets, Asbestos**  
Johns-Manville, Inc.

**Gauges, Liquid Level**  
Bristol Co.  
Pneumercator Co., Inc.

**Gauges, Pressure & Valve**  
Crane Co.  
Schaeffer & Budenberg Mfg. Co.

**Gauges, Recording & Indicating**  
Bailey Meter Co.  
Bristol Co.  
Foxboro Co.  
Pneumercator Co.  
Schaeffer & Budenberg Mfg. Co.

**Gears**  
Jeffrey Mfg. Co.  
Jones Fdy. & Mach. Co.  
Westinghouse Elec. & Mfg. Co.

**Gears, Compensating**  
Morse Chain Co.

**Generators, Oxygen & Hydrogen**  
Shriver & Co., T.

**Glass Blowing**  
Elmer & Amend

**Glassware, Chemical**  
Kimbie Glass Co.

**Graphite**  
Dixon Crucible Co., J.

**Gratings, Flooring**  
Irving Iron Works

**IF what you  
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ing for is not  
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**Gratings, Metallic**  
Irving Iron Works

**Heating App. and Systems**  
Fleisher & Co., W. L.  
Parks-Cramer Co.

**Heaters, Oil & Chemical**  
Power Specialty Co.

**Hoists, Portable**  
Ingersoll-Rand Co.

**Hose**  
Ingersoll-Rand Co.

**Hydraulic Presses**  
Perrin & Co., W. R.

**Hydro-Extractors**  
(See Extractors, Centrifugal).

**Hydrometers**  
Taylor Instrument Co.

**Injectors**  
Crane Co.

**Instruments, Elec. & Testing**  
Bristol Co.  
Pneumercator Co.  
Westinghouse Elec. & Mfg. Co.  
Weston Elec. Inst. Co.

**Instruments, Recording & Testing**  
Bristol Co.  
Central Scientific Co.  
Duval D'Adrian, A. L.

**Instruments, Tank Gauging**  
Pneumercator Co.

**Kettles, Cast Iron, Acid Proof**  
Bethlehem Fy. & Mch. Corp.

**Kettles, Enamelled, Acid Proof**  
Elvira Enamelled Prod. Co.

**Kettles, Steam-Jacketed**  
Baker Sons & Perkins Co.  
Bethlehem Fy. & Mch. Corp.  
Buffalo Fdy. & Mach. Co.  
Kelllogg Co., M. W.  
Pfaudler Co.

**Kettles, Fusion**  
Bethlehem Fdy. & Mach. Co.

**Kilns, Lime**  
Glamorgan Pipe & Fdy. Co.  
Vulcan Iron Works

**Kilns, Rotary**  
American Process Co.  
Vulcan Iron Works

**Laboratory Apparatus and Supplies**  
Braun-Knecht-Heimann-Co.  
Braun Corp.  
Central Scientific Co.  
Dainger, A., & Co.  
Denver Fire Clay Co.  
Elmer & Amend  
Hoskins Mfg. Co.  
Kauffmann-Lattimer Co.  
Schaar & Co.  
Tolhurst Mach. Works

**Lead Burning**  
Abernethy, J. F.

**Lifts, Air Jet**  
Nash Engineering Co.

**Lime**  
Gager Lime & Mfg. Co.

**Loaders, Wagon & Truck**  
Jeffrey Mfg. Co.

**Locomotives, Industrial**  
Jeffrey Mfg. Co.  
Vulcan Iron Works  
Westinghouse Elec. & Mfg. Co.

**Machinery, Agitating**  
Baker Sons & Perkins Co.  
Dorr Co., The  
Nash Engineering Co.  
New Eng. Tank & Tower Co.

**Machinery, Conveying and Elevating**  
Bartlett & Snow Co.  
Caldwell, H. W., & Son Co.  
Green Eng. Co.  
Jeffrey Mfg. Co.

**Machinery, Crushing, Grinding and Pulverizing**  
Colorado Iron Wks. Co.  
Jeffrey Mfg. Co.  
Kent Mill Co.  
Orton & Steinbrunner Co.  
Orville Simpson Co.  
Raymond Bros. Imp. Pul. Co.  
Stedman's Fdy. & Mach. Works  
Worthington Pump & Machy Corp.

**Machinery, Cyanide**  
Allis-Chalmers Mfg. Co.  
Colorado Iron Wks. Co.  
Dorr Co., The  
Pacific Tank & Pipe Co.

**Machinery, Drying**  
See Drying Machinery

**Machinery, Mixing and Kneading**  
Baker Sons & Perkins Co.  
New Eng. Tank & Tower Co.

**Machinery, Ore and Coal Handling**  
Bartlett & Snow Co.  
Jeffrey Mfg. Co.

**Machinery, Ore Concentrating**  
Dorr Co., The  
Kent Mill Co.

**Machinery, Paper Making**  
Nash Engineering Co.

**Machinery, Refrigerating**  
Ingersoll-Rand Co.  
Vogt, Henry, Machine Co.  
York Mfg. Co.

**Machinery, Screening**  
Worthington Pump & Machy Corp.

**Machinery, Special**  
Baker Sons & Perkins Co.  
Bethlehem Fdy. & Mach. Co.  
Orville Simpson Co.

**Machinery, Thickening & Dewatering**  
Dorr Co., The

**Machinery, Transmission**  
Caldwell & Sons Co., H. W.  
Jones Fdy. & Mach. Co.  
Morse Chain Co.

**Machinery, Turbine**  
Westinghouse Elec. & Mfg. Co.

**Machinery, Weighing**  
Baker Sons & Perkins Co.  
Pneumercator Co.  
Schaeffer Eng. & Equip. Co.

**Magnets**  
Dings Magnetic Separator Co.

**Masonry, Acid Proof**  
Chemical Construction Co.

**Metals, Magnesium**  
Leavitt & Co., C. W.

**Metals & Alloys**  
American Platinum Wks.  
Baker & Co.  
Calorizing Co. of Pgh.  
Fansteel Products Co.  
Hoskins Mfg. Co.  
Scovill Mfg. Co.  
Titanium Alloy Mfg. Co.  
Weston Elec. Inst. Co.

**Meters, Electric**  
Westinghouse Elec. & Mfg. Co.

**Meters, Flow, Steam, Coal, Air, Gas, Water**  
Bailey Meter Co.  
Connersville Blower Co.

**Mixers, Batch**  
See Mach., Mixing and Kneading

**Molybdenum, Sheet, Rod, Wire, Etc.**  
Fansteel Products Co.

**Monel Metal**  
Pacific Foundry Co.

**Motors, Electric**  
Fairbanks, Morse & Co.

**Nickel-Chromium Alloys**  
Hoskins Mfg. Co.

**Nitrators**  
Bethlehem Fdy. & Mach. Co.

**Nitrogen**  
Linde Air Products Co.

**Oil Circulating Systems, Industrial Heating**  
Parks-Cramer Co.  
Power Specialty Co.

**Oil and Grease Extraction Equip.**  
Bartlett & Snow Co.



**Oxy-Acetylene**

Linde Air Products Co.

**Oxygen & Hydrogen Equip.**

Linde Air Products Co.

**Paint, Pigment, Graphite**

Dixon Crucible Co.

**Pans, Vacuum**Bethlehem Fdy. & Mch. Co.  
Buffalo Fdry. & Mch. Co.  
Devine Co., J. P.  
Kestner Evaporator Co.  
Pfaudler Co.  
Zaremba Co.**Photometers**

Standard Calorimeter Co.

**Pipe Covering, Wood**

Pacific Foundry Co.

**Pipe and Fittings, Cast Iron**A. F.  
Crane Co.  
Duriron Co.**Pipe and Fittings, Stoneware, Acid Proof**General Ceramics Co.  
Knight, Maurice A.  
U. S. Stoneware Co., The**Pipe and Fittings, Wood**Michigan Pipe Co.  
Pacific Tank & Pipe Co.**Pipes, Silica Ware**

General Ceramics Co.

**Pipes, Steam Jacketed**

Parks-Cramer Co.

**Plates, Tank Steel**

Ryerson &amp; Son

**Platwork, Riveted and Welded**Bethlehem Fdy. & Mach. Co.  
Blaw-Knox Co.**Platinum Wire, Sheet, Foil, Crucibles, Dishes, Lab.**Ware, All Kinds.  
American Platinum Works.  
Baker & Co., Inc.  
Bishop, J. & Co., Plat. Wks.  
Roessler & Hasselacher Chem. Co.**Pneumatic Tools**

Ingersoll-Rand Co.

**Porcelain Ware**

Coors Porcelain Co.

**Pots & Jars, Acid-Proof**Knight, M. A.  
U. S. Stoneware Co.**Pots, Cast Iron, Acid Proof**Bethlehem Fdy. & Mach. Co.  
Duriron Co.**Powdered Coal Equipment**

Raymond Bros., Imp. P. Co.

**Pulleys, Magnetic**

Dings Magnetic Separator Co.

**Pumps, Acid Proof**American Well Works  
Oliver Continuous Filter Co.  
Worthington Pump & Machy Corp.  
United Lead Co.**Pumps, Air Lift**Ingersoll-Rand Co.  
Nash Engineering Co.**Pumps, Bilge, Brine, Circulating, Deep Well, Fire, Mine, Paper Mill, Quarry, Sewage, Sinking, Sugar-House**

American Well Works

**Pumps, Centrifugal**American Steam Pump Co.  
American Well Works  
Duriron Co.  
Fairbanks, Morse & Co.  
Ingersoll-Rand Co.  
LaBour Co.Nash Engineering Co.  
Taber Pump Co.  
Union Steam Pump Co.  
Worthington Pump & Machy Corp.**Pumps, Gas or Liquid**Beach Run Co.  
Devine Co., J. P.**Pumps, Rotary**Connersville Blower Co.  
Ingersoll-Rand Co.  
Taber Pump Co.**Pumps, Steam**Amer. Steam Pump Co.  
Ingersoll-Rand Co.  
Union Steam Pump Co.**Pumps, Triplex**

Union Steam Pump Co.

**Pumps, Vacuum**Amer. Steam Pump Co.  
Buffalo Fdry. & Mach. Co.  
Connersville Blower Co.  
Devine Co., J. P.  
Ingersoll-Rand Co.  
Oliver Continuous Filter Co.  
Wheeler, C. H. Mfg. Co.**Purifiers, Carbon**

Darco Corp.

**Pyrometer Protection Tubes**Coors Porcelain Co.  
McDaniel Refractory Porcelain Co.**Pyrometers**Bristol Co., The  
Hoskins Mfg. Co.  
Stupakoff Laboratories  
Taylor Instrument Co.**Pyroxlin Solvents**

Commercial Solvents Corp.

**Recording Instruments**Bristol Co., The  
Schaffer & Budenberg Mfg Co.**Recorders, Specific Gravity**

Bailey Meter Co.

**Reducers, Spur and Worm Gear Speed**Jones Fdy. & Mach. Co.  
Kellogg Co., M. W.**Refining Materials**

Darco Corp.

**Refractories**

Calorizing Co. of Pgh.

**Regulators, Pressure and Temperature**Bailey Meter Co.  
Bristol Co.  
Crane Co.  
Powers Regulator Co.  
Taylor Instrument Co.**Resistance Material, Elec.**

Hoskins Mfg. Co.

**Retorts, Graphite**Bartley Crucible Co., J.  
Dixon Crucible Co., J.**Rhodium**

Baker &amp; Co.

**Rods, Bronze**

Scovill Mfg. Co.

**Rolls, Crushing**

Orville Simpson Co.

**Roofing, Asbestos**Robertson Co., H. H.  
Johns-Manville Co.**Roofing, Gypsum**Robertson Co., H. H.  
Co.**Scales, Weighing**Fairbanks, Morse & Co.  
Schaffer Eng. & Equip. Co.Screens, Wire, Brass, Copper, Steel  
Cleveland Wire Cloth & Mfg. Co.**Separators, Air**

Raymond Bros. Imp. P. Co.

**Separators, Centrifugal**American Tool & Mach. Co.  
Tolhurst Mach. Works**Separators, Gas**

Petroleum Iron Wks.

**Separators, Magnetic**

Dings Magnetic Separator Co.

**Separators, Oil & Steam**

Kellogg Co., M. W.

**Sheets, Roofing and Siding, Steel**Robertson Co., H. H.  
Ryerson & Son, Jos. T.**Sifters, Centrifugal & Vibrating**Orville Simpson Co.  
Tolhurst Mach. Wks.

**I**f what you  
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**Skylights**

Robertson Co., H. H.

**Sodium Tungstate**

Fansteel Products Co.

**Solvents**

Commercial Solvents Corp.

**Spray Systems**

Spray Eng. Co.

**Sprockets**Jeffrey Mfg. Co.  
Jones Fdy. & Mach. Co.  
Morse Chain Co.**Steel, Cold, Rolled**

Harrisburg Pipe &amp; Pipe Bending Co.

**Steel, Fabricated**

Harrisburg Pipe &amp; Pipe Bending Co.

**Stacks, Smoke, Steel**Kittice Boiler & Tank Co.  
Petroleum Iron Wks.**Steel Plate Construction**Hammond Iron Works  
Kittice Boiler & Tank Co.  
Petroleum Iron Works  
Pittsburgh-Des Moines Steel  
Sharpsville Boiler Works Co.**Steel, Structural**

Ryerson, Jos. T., &amp; Son Co.

**Steps, Safety**

Irving Iron Works

**Stillis, Heating**

Bethlehem Fdy. &amp; Mach. Co.

**Stillis, Oil, Tar, etc.**Hammond Iron Works  
Petroleum Iron Works**Stillis, Water**

Barnstead Still &amp; Sterilizer

**Stokers**Babcock & Wilcox Co.  
Green Eng. Co.  
Hagan Co., Geo. F.Stoneware, Acid Proof Chem-  
ical (Consisting of Bottles,  
Carboy Stoppers, Coils and  
Worms Crystallizing Dishes,  
Decanting Pots, Dippers,  
Dipping Dishes, Funnels,  
Funnels, Kettles, Nozzles  
and Jets, Pots and Jars,  
Pipe Fittings, Pitchers, Re-  
torts, Receivers or Wouff  
Bottles, Sinks, Storage,  
Jars, Towers, etc.)Acid Proof Clay Prods. Co.  
General Ceramics Co.  
Knight, M. A.  
U. S. Stoneware Co.**Stirrers, Acid Proof**

Duriron Co.

**Sulphur**

Union Sulphur Co., The

**Sulphuric Acid Plants**

Chemical Construction Co.

**Sulphonators**

Bethlehem Fdy. &amp; Mach. Co.

**Superheaters**Babcock & Wilcox Co.  
Power Specialty Co.**Switches**Westinghouse Elec. & Mfg.  
Co.**Tachometers**Schaffer & Budenberg Mfg.  
Co.**Tanks, Acid, Chemical, Oil**Hammond Iron Works  
Hauser-Stander Tank Co.  
Kittice Boiler & Tank Co.  
Lancaster Iron Works  
National Tank & Pipe Co.  
Petroleum Iron Works  
Sharpsville Boiler Works**Tanks, Acid Proof, Stone-  
ware**

See Stoneware, Chemical, etc.

**Tanks, Cast Iron, Steel**Bethlehem Fdy. & Mach. Co.  
Caldwell Co., W. E.  
Hammond Iron Works  
Harrisburg Pipe & Pipe  
Bending Co.  
New Eng. Tank & Tower Co.  
Petroleum Iron Works**Tanks, Chemical**

U. S. Stoneware Co.

**Tanks, Enameled**Elyria Enameled Products  
Co.**Tanks, Lead Lined**Abernethy, J. F.  
Bethlehem Fdy. Mach. Co.  
Hauser-Stander Tank Co.  
New Eng. Tank & Tower Co.  
United Lead Co.**Tanks, Pressure & Storage**Hammond Iron Works  
Harrisburg Pipe & Pipe  
Bending Co.  
Kellogg Co., M. W.  
Kittice Boiler & Tank Co.  
Lancaster Iron Works  
Sharpsville Boiler Works  
Petroleum Iron Works  
Pittsburgh-Des Moines Steel  
Co.**Tanks, Stoneware**General Ceramics Co.  
Knight, M. A.  
U. S. Stoneware Co.**Tanks, Wood**Caldwell Co., W. E.  
Hauser-Stander Tank Co.  
Kalamazoo Tank & Silo Co.  
National Tank & Pipe Co.  
New Eng. Tank & Tower Co.  
Pacific Tank & Pipe Co.Thermometers, Recording  
Flue Gas, etc.  
Foxboro Co.**Thermometers, Recording  
Flue Gas, etc.**Bristol Co.  
Schaffer Budenberg Mfg.  
Co.  
Taylor Instrument Co.**Titanium and Orew**

Titanium Alloy Mfg. Co.

**Towers & Accessories, Acid  
Proof Stoneware**

See Stoneware, Chemical, etc.

**Towers, Acid**Duriron Co.  
Hauser-Stander Tank Co.  
M. A. Knight  
National Tank & Pipe Co.  
U. S. Stoneware Co.**Towers, Water Cooling**

Wheeler, C. H., Mfg. Co.

**Transformers**Allis-Chalmers Mfg. Co.  
Amer. Transformer Co.**Transformers, Special and  
Precipitation Process**

Amer. Transformer Co.

**Transmission, Silent Chain**

Morse Chain Co.

**Traps, Air, Steam**

Powers Regulator Co.

**Tube, Condenser, Admiralty**Brass  
Scovill Mfg. Co.**Tungsten Metals**

Fansteel Products Co.

**Turbo Blowers**

See Blowers, Turbo

**Uranium Alloys**

Standard Alloys Co.

**Valves, Balance, Lever, Float,  
Reducing, Pressure, Back  
Pressure**

Powers Regulator Co.

**Valves and Cocks, Stoneware,  
Acid Proof**

See Stoneware, Chemical

**Valves & Fittings, Acid Proof**Pacific Foundry Co.  
Knight, M. A.  
Vort Machine Co., H.  
United Lead Co.**Vanadium Alloys**

Standard Alloys Co.

**Vats, Wood**Hauser-Stander Tank Co.  
National Tank & Pipe Co.  
New Eng. Tank & Tower  
Co.  
Pacific Tank & Pipe Co.**Ventilating App.**Fleisher & Co., W. L.  
Sturtevant Co., B. F.**Ventilators**

Robertson Co., H. H.

**Water Purification, Rectifica-  
tion and Softening**

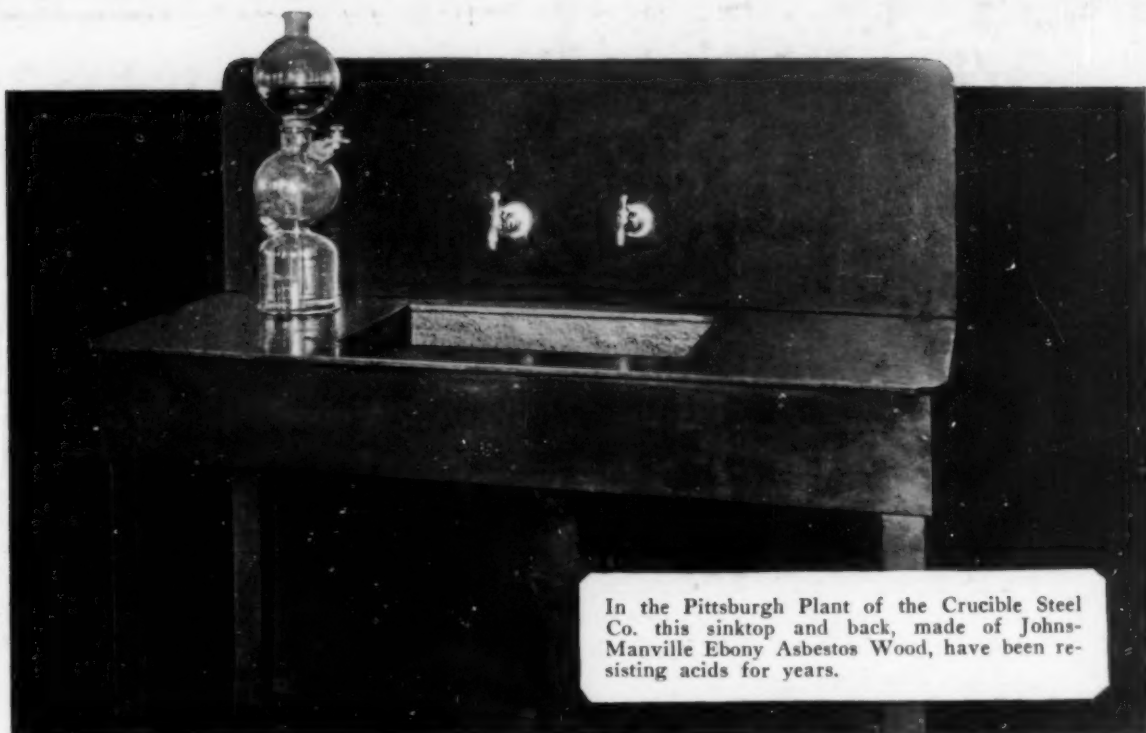
Electron Chemical Co.

**Welding**Blaw-Knox Co.  
Hoskins Mfg. Co.**Wire Cloth**Baker & Co.  
Cleveland Wire Cloth Mfg.  
Ludlow-Saylor Wire Co.**Wood Distillation Plants &  
App.**

Zaremba Co.







In the Pittsburgh Plant of the Crucible Steel Co. this sinktop and back, made of Johns-Manville Ebony Asbestos Wood, have been resisting acids for years.

## A saw's teeth bit it— but acid hasn't

This sink top and back are made of a material whose unusual qualities render it useful all around the chemical plant.

Ebony Asbestos Wood can be cut, sawed, nailed and fitted like ordinary lumber. But unlike lumber it resists acids, it is not affected by water, oil or gases, and it has great mechanical strength and all the fire-proofness of rock.

And that's because Ebony Wood is rock-formed of asbestos fibre and binding cements under enormous pressure and impregnated with a special compound.

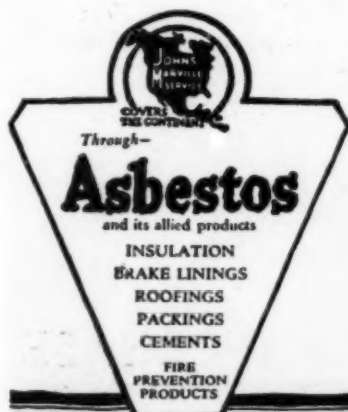
Its unique properties make it

ideal for vents and ducts, for vats and containers, for laboratory tabletops, hood-linings and sinks.

### Of interest to your Electrical Department

Ebony Wood one inch in thickness has a dielectric strength of 76,000 volts. (Your handbook will show slate and marble pretty far down the list). For switchboards, panelboards and electrical appliance bases, Ebony Wood will meet the most exacting tests through years of service.

JOHNS-MANVILLE Incorporated  
Madison Ave. at 41st St., New York City  
Branches in 57 Large Cities  
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# JOHNS-MANVILLE

## Ebony Asbestos Wood

## Where conditions are Super-exacting

Where it is necessary to protect the working parts from dampness—chemical fumes or dust—you ought to install

TRADE MARK  
**BRISTOL'S**  
REG. U. S. PAT. OFFICE.

### Recording Pressure Gauges

in the Moisture-Proof case. The charts prevent disputes—enable you to tell exactly where processes can be improved—they turn uncertainty into certainty. A more rugged style of case is available in our Waterproof Model. The interior is completely protected even if immersed in water.

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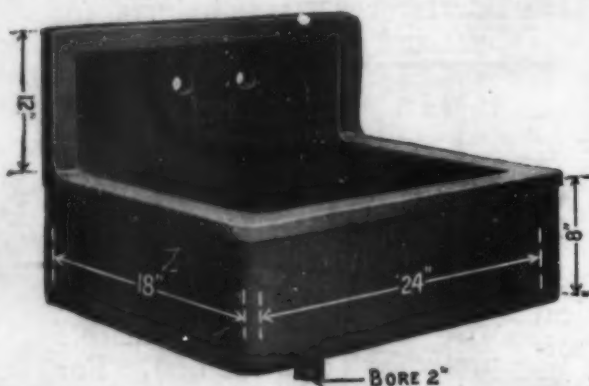


FIGURE 237

**ACID-PROOF LABORATORY SINK, WITH BACK**  
Made in any size or design. With or without back. We make acid-proof traps and waste lines, with all kinds of fittings.



FIGURE 185

**FLANGED RIM KETTLE. 25 GALLONS**

Made in any size from 5 to 100 gallons capacity. Used with sand, water or oil bath for heating.



**Maurice A. Knight**  
East Akron, Ohio  
**Tanks and Vessels**  
made of  
**Acid-Proof Chemical  
Stoneware**

*Clean and Sanitary*

Our plant is the only plant in America which is devoted entirely to the manufacture of acid-proof chemical stoneware.

A Stoneware that is Acid Proof and Vitrified All through.

Our Ware is not Dependent upon a Glaze, Enamel or Veneer.

*It is the body itself.*

Withstands the action of Acids, Alkalis and Chemicals, strong or weak, hot or cold.

**ACID LEAKS INCREASE  
PRODUCTION COSTS**



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